الجمهورية الجزائرية الديمقراطية الشعبية
People's Democratic Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research
اللجنة البيداغوجية الوطنية لميدان العلوم و التكنولوجيا
National Pedagogical Committee for the Sciences and Technology Field

HARMONIZED ACADEMIC MASTER'S PROGRAM

National Curriculum

Updated 2022

Field	Program	Specialization
Science and Technology	***Civil Engineering***	***Geotechnical Engineering***

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مواءمة
ماستر أكاديمي

تحيين 2022

الميدان	الفرع	التخصص
علوم و تكنولوجيا	هندسة مدنية	جيوتقني

I – Master Program Identity Sheet

Access Conditions

Program	Harmonized Master	Bachelor's Degrees Eligible for Admission	Ranking Based on Compatibility	Coefficient
Civil Engineering	Geotechnical Engineering	Civil Engineering	**1**	**1.00**
		Hydraulic Engineering	**1**	**1.00**
		Public Works	**1**	**1.00**
		Mining Engineering	**3**	**0.70**
		Other degrees in the ST field	**5**	**0.60**

II – Semester-wise Organization of Courses:

Semestre 1 Master : Geotechnical Engineering

Teaching Unit	Courses	Credits	Coefficient	Weekly Hours			Semester Hours (15 weeks)	Additional Consultation Work (15 weeks)	Assessment Method	
	Title			**Lecture**	**Tutorial (TD)**	**Practical (TP)**			**Continuous Assessment**	**Exam**
Core Unit (CU Fundamental) Code: CUF 1.1.1 Credits: 8 Coefficient: 4	Continuum Mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Advanced Soil Mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
CU Fundamental Code : CUF 1.1.2 Credits : 10 Coefficients : 5	Slopes and Retaining Structures	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%
CU Methodological Code : CUM 1.1 Credits : 9 Coefficients : 5	Programming Complement	3	2	1h30		1h00	37h300	37h30	40%	60%
	Experimental Methods	2	1	1h30			22h30	27h30		100%
	Geotechnical Tests & Site Investigation 1	4	2	1h30		1h30	45h00	55h00	40%	60%
CU Discovery Code : UED 1.1 Credits : 2 Coefficients : 2	*Elective Courses*	1	1	1h30			22h30	02h30		100%
	Elective Courses	1	1	1h30			22h30	02h30		100%
CU Transversal Code : UET 1.1 Credits : 1 Coefficients : 1	Technical English and Terminology	1	1	1h30			22h30	02h30		100%
Total semestre 1		**30**	**17**	**16h30**	**6h00**	**2h30**	**375h00**	**375h00**		

Semestre 2 Master : Geotechnical Engineering

Teaching Unit	Courses	Credits	Coefficient	Weekly Hours			Semester Hours (15 weeks)	Additional Consultation Work (15 weeks)	Assessment Method	
	Title			**Lecture**	**Tutorial (TD)**	**Practical (TP)**			**Continuous Assessment**	**Exam**
Core Unit (CU Fundamental) Code: CUF 1.1.1 Credits: 8 Coefficient: 4	Mechanics of Deformable Solids	4	2	1h30	1h30		45h00	55h00	40%	60%
	Soil Dynamics	4	2	1h30	1h30		45h00	55h00	40%	60%
CU Fundamental Code : CUF 1.1.2 Credits : 10 Coefficients : 5	Soil Rheology	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%
CU Methodological Code : CUM 1.1 Credits : 9 Coefficients : 5	Finite Element Method	5	3	1h30	1h00	1h30	60h00	65h00	40%	60%
	Geotechnical Tests & Site Investigation 2	4	2	1h30		1h30	45h00	55h00	40%	60%
CU Discovery Code : UED 1.1 Credits : 2 Coefficients : 2	*Elective Courses*	1	1	1h30			22h30	02h30		100%
	Elective Courses	1	1	1h30			22h30	02h30		100%
CU Transversal Code : UET 1.1 Credits : 1 Coefficients : 1	Ethics, Integrity and Norm Compliance	1	1	1h30			22h30	02h30		100%
Total semestre 2		**30**	**17**	**15h00**	**7h00**	**3h00**	**375h00**	**375h00**		

Semestre 3 Master : Geotechnical Engineering

Teaching Unit	Courses	Credits	Coefficient	Weekly Hours			Semester Hours (15 weeks)	Additional Consultation Work (15 weeks)	Assessment Method	
	Title			**Lecture**	**Tutorial (TD)**	**Practical (TP)**			**Continuous Assessment**	**Exam**
Core Unit (CU Fundamental) Code: CUF 1.1.1 Credits: 8 Coefficient: 4	Geotechnical Structure Dynamics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Limit Analysis and Failure Mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
CU Fundamental Code : CUF 1.1.2 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%
CU Methodological Code : CUM 1.1 Credits : 9 Coefficients : 5	Ground Improvement	4	2	1h30		1h30	45h00	55h00	40%	60%
	Geotechnical Structure Modeling	2	1			1h30	22h30	27h30	100%	
	Geographic Information Systems	3	2	1h30		1h00	37h30	37h30	40%	100%
CU Discovery Code : UED 1.1 Credits : 2 Coefficients : 2	*Elective Courses*	1	1	1h30			22h30	02h30		100%
	Elective Courses	1	1	1h30			22h30	02h30		100%
CU Transversal Code : UET 1.1 Credits : 1 Coefficients : 1	Research Methods and Thesis Writing	1	1	1h30			22h30	02h30		100%
Total semestre 3		**30**	**17**	**15h00**	**6h00**	**4h00**	**375h00**	**375h00**		

Elective Course Basket (S1, S2, S3)*:*

1. *Hydrogeology*
2. *Geotechnical Hazards and Risks*
3. *Finite Difference Method*
4. *Discrete Element Method*
5. *Site Organization*
6. *Pathologies of Geotechnical Structures*
7. *Public Procurement Code*
8. *Geotechnical Standards*
9. *Construction Law*
10. *Safety Plan for Geotechnical Works*
11. *Basics of Civil and Industrial Construction*
12. *Basics of Roads and Civil Structures*
13. *Basics of Hydraulic Structures*

Semestre 4

Professional Internship (in a company or research lab), culminating in a thesis and defense.

	Activity Workload (hours)	Coeff.	Credits
Personal Work	550	09	18
Internship (Company or Lab)	100	04	06
Seminars	50	02	03
Supervision/Other Activities	50	02	03
Total Semestre 4	750	17	30

This table is given for information purposes only.

Master's Thesis Evaluation Criteria

- Scientific Merit (Jury) /6
- Thesis Writing (Jury) /4
- Presentation and Q&A (Jury) /4
- Supervisor's Evaluation /3
- Internship Report Presentation (Jury) /3

III - Detailed Course Program for Semester 1

Semester: 1
Teaching Unit: CUF 1.1.1
Course Title: Continuum Mechanics
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

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

Recommended Prerequisites:

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

Course Content:

Chapter 1.	General Concepts	**(1 week)**
Chapter 2.	Mathematical Preliminaries	**(2 weeks)**
Chapter 3.	Theory of Stress State	**(4 weeks)**
Chapter 4.	Theory of Strain State	**(4 weeks)**
Chapter 5.	Constitutive Relations	**(4 weeks)**

Assessment Method:

Continuous Assessment: 40%; Final Exam: 60%

References:

1. *P. Germain. Continuum Mechanics. Ed. Masson.*
2. *P. Germain, P. Muller. Introduction to Continuum Mechanics. Ed. Masson.*
3. *J. Salençon. Continuum Mechanics, Vol. 1, 2, and 3. Ed. École Polytechnique, France.*
4. *J. Coirier, C. Nadot-Martin. Continuum Mechanics. Ed. Dunod.*
5. *G. Duvaut. Continuum Mechanics. Ed. Masson.*
6. *J. Botsis, M. Deville. Continuum Mechanics. Ed. Eyrolles.*
7. *R. Temam, A. Miranville. Mathematical Modeling and Continuum Mechanics. Ed. Springer.*

Semester: 1
Teaching Unit: CUF 1.1.1
Course Title: Advanced Soil Mechanics
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

This course aims to provide students with in-depth theoretical and experimental knowledge about the mechanical behavior of granular and fine soils in both saturated and unsaturated states.

Recommended Prerequisites:

Soil Mechanics 1 and 2

Course Content:

Chapter 1 : Review of Granular and Fine Soils (3 weeks)
I-1 : Difference between granular and fine soils
I-2 : Properties of granular soils
I-3 : Properties of fine soils
I-4 : Plasticity and shear strength
I-5 : Short- and long-term behaviour
I-6 : Stress paths in ($\sigma - \varepsilon$) and ($p - q$) space

Chapter 2 : Behaviour of Granular Materials (4 weeks)
II-1 : Stress-strain relationship
II-2 : Dilatancy theory
II-3 : Critical and characteristic states
II-4 : Lateral stress influence
II-5 : Behaviour under cyclic loading: contraction, dilation, and liquefaction

Chapter 3 : Behaviour of Fine Soils (4 weeks)
III-1 : Clay shear, over-consolidated and normally consolidated states, drained and undrained conditions, pore pressure, failure criteria, total stress envelope.
III-2 : Consolidation state and shear strength
III-3 : Relationship between consolidation pressure and Cu (undrained shear strength)

Chapter 4 : Behaviour 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

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *F. Schlosser. Elements of Soil Mechanics. Ed. Presses des Ponts, France.*
2. *F. Schlosser. Exercises in Soil Mechanics. Ed. Presses des Ponts, France.*
3. *J. Costet, G. Sanglerat. Practical Course in Soil Mechanics, Vol. 1 & 2. Ed. Dunod.*
4. *G. Sanglerat, G. Olivari, B. Cambou. Practical Problems in Soil Mechanics and Foundations, Vol. 1 & 2. Ed. Dunod.*
5. *G. Philipponnat, B. Hubert. Foundations and Earthworks. Ed. Eyrolles.*
6. *D. Cordary. Soil Mechanics. Ed. Lavoisier.*
7. *Robert D. Holtz, William D. Kovacs. Introduction to Geotechnical Engineering. Ed. École Polytechnique de Montréal, Canada.*
8. *Braja M. Das. Advanced Soil Mechanics. Ed. Taylor & Francis Group.*
9. *P. Delage, Y. J. Cui (2001). Mechanical Behavior of Unsaturated Soils. Techniques de l'Ingénieur.*
10. *O. Coussy, J. M. Fleureau (2002). Mechanics of Unsaturated Soils. Hermes Science Publications.*

Teaching Unit: CUF 1.1.2
Course Title: Slopes and Retaining Structures
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

This course aims to deepen students' understanding of slope stability analysis and the design and calculation of retaining structures.

Recommended Prerequisites:

Soil Mechanics 1 & 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 with circular failure	**(3 weeks)**
Chapter 3.	Stability with arbitrary failure surfaces	**(3 weeks)**

- **Second Part :** *Retaining Structures*

Chapter 4.	Classification of retaining structures	**(1 weeks)**
Chapter 5.	Loads and stress analysis	**(3 weeks)**
Chapter 6.	Design and justification	**(3 weeks)**

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *F. Schlosser. Elements of Soil Mechanics. Ed. Presses des Ponts, France*
2. *F. Schlosser. Exercises in Soil Mechanics. Ed. Presses des Ponts, France*
3. *J. Costet, G. Sanglerat. Practical Course in Soil Mechanics, Vol. 1 & 2. Ed. Dunod*
4. *G. Sanglerat, G. Olivari, B. Cambou. Practical Problems in Soil Mechanics and Foundations, Vol. 1 & 2. Ed. Dunod*
5. *G. Philipponnat, B. Hubert. Foundations and Earthworks. Ed. Eyrolles*
6. *J.L. Durville, G. Sève. Slope Stability: Landslides in Soft Ground (C254), Techniques de l'Ingénieur*
7. *F. Schlosser. Retaining Structures: Earth Pressure and Resistance (C242), Techniques de l'Ingénieur*

Semester: 1
Teaching Unit: CUF 1.1.2
Course Title: Foundations
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

This course aims to enable students to master the design and calculation of shallow and deep foundations for civil engineering structures.

Recommended Prerequisites:

Soil Mechanics 1 & 2
Foundations and Geotechnical Structures.

Course Content:

Chapter 1.	Types of loads and calculation conditions	**(2 weeks)**
Chapter 2.	Shallow foundations	**(5 weeks)**
Chapter 3.	Deep foundations	**(5 weeks)**
Chapter 4.	Special foundations	**(3 weeks)**

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *F. Schlosser. Elements of Soil Mechanics. Ed. Presses des Ponts*
2. *F. Schlosser. Exercises in Soil Mechanics. Ed. Presses des Ponts*
3. *J. Costet, G. Sanglerat. Practical Course in Soil Mechanics, Vol. 1 & 2. Ed. Dunod*
4. *G. Sanglerat, G. Olivari, B. Cambou. Practical Problems in Soil Mechanics and Foundations, Vol. 1 & 2. Ed. Dunod*
5. *G. Philipponnat, B. Hubert. Foundations and Earthworks. Ed. Eyrolles*
6. *R. Frank. Shallow Foundations (C246), Techniques de l'Ingénieur*
7. *R. Frank. Deep Foundations (C248), Techniques de l'Ingénieur*
8. *R. Frank. Shallow and Deep Foundations. Ed. Presses des Ponts*
9. *P. Bousquet. Piles and Sheet Piles (C140), Techniques de l'Ingénieur*
10. *Robert D. Holtz, William D. Kovacs. Introduction to Geotechnical Engineering. École Polytechnique de Montréal, Canada*

Semester: 1
Teaching Unit: CUM 1.1
Course Title: Applied Geophysics
Total Hours: 22h30 (Lecture: 1h30/week)
Credits: 2
Coefficient: 1

Course Objectives:

This course introduces students to theoretical and experimental principles of applied geophysics in civil engineering.

Recommended Prerequisites:

Soil Mechanics 1 & 2 and Continuum Mechanics.

Course Content:

Chapter 1.	Generalities on geophysics and its applications *(Geophysics and geotechnical investigations, Physical parameters measured, Geophysical survey 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)**

Lab Program (Based on availability of geophysical testing platforms)

Assessment Method:

Final Exam: 100%

References:

1. *J. Dubois, M. Diament, J.P. Cogné. Geophysics. Ed. Dunod*
2. *L. Lliboutry. Geophysics and Geology. Ed. Elsevier-Masson*
3. *R. Lagabrielle. Applied Geophysics for Civil Engineering (C224), Techniques de l'Ingénieur*
4. *M. Chouteau, B. Giroux. Applied Geophysics II – Electrical Methods, École Polytechnique de Montréal*
5. *H. Shout, M. Djeddi. Physical Bases of Seismic Prospecting. Ed. OPU, Algeria*

Semester: 1
Teaching Unit: CUM 1.1
Course Title: Programming Complement
Total Hours: 37h30 (Lecture: 1h30/week, Practical: 1h00/week)
Credits: 3
Coefficient: 2

Course Objectives:

This course aims to deepen students' understanding of advanced programming techniques relevant to engineering applications.

Recommended Prerequisites:

General computing knowledge, Familiarity with at least one 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)**

Assessment Method:

Continuous Assessment: 40% ; Exam: 60%.

References:

1. *J.C. Mitchell. Concepts in Programming Languages, Prentice Hall, 1997*
2. *M. Boumahraat, A. Gourdin. Applied Numerical Methods, OPU, 1993*
3. *Varga. Matrix Iterative Analysis, Prentice Hall, 1962*
4. *Bestougeff. Computer Techniques: Numerical and Non-Numerical Algorithms, Vol. 2, Masson, 1975*

Semester: 1
Teaching Unit: CUM 1.1
Course Title: Experimental Methods
Total Hours: 22h30 (Lecture: 1h30/week)
Credits: 2
Coefficient: 1

Course Objectives:

This course provides students with up-to-date knowledge on standard soil mechanics testing, especially in the lab but also in the field.

Recommended Prerequisites:

Soil Mechanics 1 & 2.

Course Content:

Chapter 1 : Testing standards, experimental procedures, and result interpretation (in-situ and lab 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)**

Assessment Method:

Exam: 100 %.

References:

All standard textbooks on Soil Mechanics

Semester: 1
Teaching Unit: CUM 1.1
Course Title: Geotechnical Testing and Site Investigation 1
Total Hours: 45h00 (Lecture: 1h30/week, Practical: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

This course presents the various types of in-situ and laboratory tests commonly used in soil mechanics.

Recommended Prerequisites:

Soil Mechanics 1 & 2

Course Content: Topics (spread over S1 and S2)

- Drilling and sampling
- In-situ tests (Part 1)
- Laboratory tests (Part 1)

N.B. The professor has the free choice to schedule the different types of in-situ and laboratory tests available in his faculty in addition to those already carried out in the 1st cycle (license) which he will have to divide into two semesters: S1 (for the 1st part) and S2 (for the 2nd part).

Suggested Breakdown:

I- Drilling and boring (definition, techniques, core drilling, density, investigation depth) **2 weeks**
II- Sampling and geotechnical properties **2 weeks**
III- Mechanical tests (SPT, CPT, pressuremeter, vane shear tests) **2 weeks**
IV- Destructive drilling & borehole logging **1 week**
V- Instrumentation and structural monitoring **2 weeks**
VI- Geotechnical study process / Geotechnical Investigations (geotechnical engineer's mission, preliminary investigation, the different phases and program of the geotechnical study) **2 weeks**
VII- Variability and uncertainty in measurements (heterogeneity, soil variability, measurement uncertainties) **2 weeks**
VIII- Choosing investigation techniques. **2 weeks**

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

References:

1. *M. Cassan (1988), In situ testing in soil mechanics. 1. Implementation and interpretation. Eyrolles Publishing.*
2. *M. Rat (1974), Soil investigation. Engineering techniques, Ref. C224 V1.*
3. *P. Reiffsteck, D. Lossy, J. Benoît (2012), Geotechnical drilling, surveys, and in situ testing: Tools for soil and rock investigation. Publisher: Presses Des Ponts.*
4. *P. Reiffsteck, M. Zerhouni, J.-L. Averlan (2018), Laboratory tests for soil mechanics and geotechnics: tools for soil and rock investigation. Presses de l'École nationale des ponts et chaussées.*
5. *Roy E. Hunt (2005), Geotechnical investigation methods: a field guide for geotechnical engineers. CRC Press LLC, 2005.*
6. *Keith Lawrence H. (1992), Environmental Sampling and Analysis: A Practical Guide, Lewis Publisher, Chelsea, Michigan.*
7. *AFTES Recommendations (2012), Characterization of Geological, Hydrogeological, and Geotechnical Uncertainties and Risks (GT32 R2 F1), 2012.*
8. *G. Philipponnat, B. Hubert (1998), Foundations and Earthworks, Eyrolles Publishing.*
9. *H. Cambefort (1972), Engineering Geotechnics and Soil Investigation, Eyrolles Publishing.*
10. *Union Syndicale Géotechnique – Standard Geotechnical Missions (Standardization Project), 1996.*
11. *Martin Van Staveren (2006), Uncertainty and Ground Conditions: A Risk Management Approach, Elsevier.*

Semester: 1
Teaching Unit: CUT 1.1
Course Title: Technical English and Terminology
Total Hours: 22h30 (Lecture: 1h30/week)
Credits: 1
Coefficient: 1

Course Objectives:

To introduce students to technical vocabulary, strengthen language skills, and help them understand and synthesize technical documents in English.

Recommended Prerequisites:

Basic English vocabulary and grammar.

Course Content:

- **Reading:** Analysis of texts related to the geotechnical field
- **Listening:** Using scientific videos, note-taking, summarizing, and presentations
- **Speaking:** Oral presentation of technical topics, discussion, phone communication
- **Writing:** Extracting ideas, scientific writing, CVs, and cover letters
- **Tip:** Instructors are encouraged to explain around 10 technical terms per session in English, French, and Arabic (if possible).

Recommendation:
It is strongly recommended that the subject leader present and explain at the end of each session (at most) a dozen technical terms related to the specialty in three languages (if possible): English, French, and Arabic.

Assessment Method:

Exam: 100%.

References:

1. *P.T. Danison. A Practical Guide to Writing in English: Usage and Rules, Practical Advice. Editions d'Organisation.*
2. *A. Chamberlain, R. Steele. A Practical Guide to Communication: English. Ed. Didier.*
3. *R. Ernst. Dictionary of Applied Technology and Sciences: French-English. 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.*

II. Detailed Course Program for Semester 2

Semester: 2
Teaching Unit: CUF 1.2.1
Course Title: Mechanics of Deformable Solids
Total Hours: 67h30 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To introduce students to the theoretical and experimental concepts of deformable solid mechanics.

Recommended Prerequisites:

Rational Mechanics, Thermodynamics and Continuum Mechanics.

Course Content:

Chapter 1.	Physical mechanisms of deformation and rupture	**(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%

References:

1. *J. Lemaitre, J.L. Chaboche. Mechanics of Deformable and Damaged Solids. Ed. Dunod*
2. *D. François, A. Pineau, A. Zaoui. Elasticity and Plasticity. Ed. Lavoisier*
3. *S. Timoshenko, J.M. Goodier. Theory of Elasticity. Ed. Librairie Polytechnique*
4. *J. Salençon. Elastoplasticity. Ed. École Polytechnique, France*
5. *V.A. Lubarda. Elastoplasticity Theory. Ed. CRC Press*
6. *R. Richards Jr. Principles of Solid Mechanics. Ed. CRC Press*
7. *R.J. Asaro, V.A. Lubarda. Mechanics of Solids and Materials. Ed. Cambridge University Press*

Semestre : 2
Teaching Unit: CUF 1.2.1
Course Title: Soil Dynamics
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To introduce students to the dynamic analysis of soils and foundations of geotechnical structures.

Recommended Prerequisites:

Waves and Vibrations, Soil Mechanics 1 & 2, Foundations and Continuum Mechanics.

Course Content:

Chapitre 1.	Seismic motion characterization *(Seismology basics, wave propagation in soil, polarization, Algeria's seismic history)*	**(3 weeks)**
Chapter 2.	Soil behaviour under cyclic loading	**(3 weeks)**
Chapter 3.	Measurement of dynamic soil properties	**(3 weeks)**
Chapter 4.	Seismic response of soil profiles	**(3 weeks)**
Chapter 5.	Soil liquefaction	**(3 weeks)**

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *A. Bouafia. Introduction to soil dynamics. Volumes 1 & 2. Ed. OPU, Algeria.*
2. *A. Pecker. Soil dynamics. 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: CUF 1.2.2
Course Title: Soil Rheology
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To provide students with advanced theoretical and experimental knowledge of soil behavior under homogeneous loading, with applications in foundation and geotechnical structure design.

Recommended Prerequisites:

Soil Mechanics 1 & 2, Continuum Mechanics.

Course Content:

Chapter1. In-situ and laboratory behaviour **(1 week)**
(Compressibility, permeability, consolidation, creep, shear strength, stress paths, normal vs. over-consolidated behaviour)

Chapter 2. Elastic behaviour laws **(4 weeks)**
(Linear elasticity, nonlinear elasticity, application to hyperbolic models)

Chapter 3. Elasto-plastic behaviour laws **(4 weeks)**
(Perfect plasticity, plasticity with hardening, CAM-CLAY model)

Chapter 4. Elasto-visco-viscoplastic behavior laws **(4 weeks)**
(Incorporating creep, MELANIE-LCPC model)

Chapter 5. Numerical implementation **(2 weeks)**
(Overview of rheological models used in software such as PLAXIS, FLAC, CESAR-LCPC.)

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

Références bibliographiques:

1. *J.P. Magnan, P. Mestat. Behavior Laws and Soil Modeling (C218). Techniques de l'ingénieur*
2. *P. Mestat. From Soil Rheology to Structure Modeling. IFSTTAR (ex-LCPC)*
3. *B.M. Das. Advanced Soil Mechanics. Taylor & Francis*
4. *S.S. Vyalov. Rheological Fundamentals of Soil Mechanics. Elsevier*
5. *M.J. Keedwell. Rheology and Soil Mechanics. Elsevier*
6. *D. Muir Wood. Geotechnical Modelling. CRC Press*

Semestre:3
Teaching Unit: CUF 1.2.2
Course Title: Geostatistics
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To introduce students to theoretical concepts of statistical analysis applied to geotechnics.

Recommended Prerequisites:

Statistics and Soil Mechanics.

Course Content:

Chapter 1.	Theoretical foundations of geo-statistics (Random functions, stationarity, covariance, variogram modelling)	**(3 weeks)**
Chapter 2.	Variogram analysis	**(4 weeks)**
Chapter 3.	Kriging theory	**(4 weeks)**
Chapter 4.	Software and applications	**(4 weeks)**

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

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*

Semestre:2
Teaching Unit: CUF 1.2.2
Course Title: Earth Dams
Total Hours: 22h30 (Lecture: 1h30/week)
Credits: 2
Coefficient: 1

Course Objectives:

To introduce students to the design and analysis of earth dams.

Recommended Prerequisites:

Advanced Soil Mechanics, Foundations, Slopes and Retaining Structures, Finite Difference and Finite Element Methods.

Course Content:

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

Chapter II : Seepage analysis of earth dams **(4 weeks)**
- mpermeable cutoffs,
- upstream face protection,
- drains and filters

Chapter III : Seepage control methods in the earth dams **4 weeks)**
- Ecrans imperméables
- Revêtement du parement amont
- Drains et filtres

Chapter IV : Earth Dams stability **(3 weeks)**
- Fellenius methods
- Bishop methods

Assessment Method:

Exam:100%

References:

1. *A.J. Schleiss, H. Pougatsch. Dams – From Design to Commissioning. Presses Polytechniques et Universitaires Romandes*
2. *P. Le Delliou. Dams: Design and Maintenance. Presses Universitaires de Lyon*
3. *L. Vulliet, L. Laloui, J. Zhao. Soil and Rock Mechanics. Presses Polytechniques et Universitaires Romandes*

Semester: 2
Teaching Unit: CUM 1.2
Course Title: Finite Element Method
Total Hours: 60h00 (Lecture: 1h30/week, Tutorial: 1h00/week, Practical: 1h30/week)
Credits: 5
Coefficient: 3

Course Objectives:

This course aims to introduce students to the design and analysis of geotechnical structures using the Finite Element Method (FEM).

Recommended Prerequisites:

Mathematical Analysis, Matrix Calculations, Strength of Materials, Numerical Methods, Soil Mechanics 1 & 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 Sessions TP

Part 1 (using MATLAB or equivalent): Matrix operations, Lagrange interpolation, Numerical integration (Trapezoidal and Simpson's rule) and Practical applications.

Part 2 (using FEM software such as PLAXIS): Software presentation, Model setup (geometry, soil layers, boundary and initial conditions, loading, structural elements), Phase definition, result presentation, and interpretation.

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *G. Dhatt, G. Touzot, E. Lefrançois. Finite Element Method. Ed. Hermès-Lavoisier*
2. *J. Chaskalovic. Finite Element Method for Engineering Sciences. Ed. Lavoisier*
3. *J.C. Craveur. Finite Element Modeling. Ed. Dunod*
4. *M. Bonnet, A. Frangi. Analysis of Deformable Solids by FEM. Ed. École Polytechnique, France*
5. *F. Frey, J. Jirousek. Finite Element Method. Ed. Eyrolles*

Semester: 2
Teaching Unit: CUM 1.2
Course Title: Geotechnical Testing and Site Investigation 2
Total Hours: 45h00 (Lecture: 1h30/week, Practical: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

This course introduces students to the various types of in-situ and laboratory tests used in soil mechanics.

Recommended Prerequisites:

Soil Mechanics 1 and 2

Course Content:

- Boreholes and sampling
- In-situ tests (Part 2)
- Laboratory tests (Part 2)

Note: The instructor has full discretion to schedule the in-situ and lab tests available at their institution. These should complement the tests already carried out during the Bachelor's program, and be distributed over two semesters:
Semester 1 → Part 1

Semester 2 → Part 2

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

All standard textbooks in soil mechanics.

Semester: 2
Teaching Unit: CUT 1.2
Course Title: Compliance with Standards, Ethics, and Integrity Rules
Total Hours: 22h30 (Lecture: 1h30/week)
Credits: 1
Coefficient: 1

Course Objectives:

To raise student awareness of ethical principles and the rules that govern academic life and professional environments. It also aims to foster respect for and protection of intellectual property, inform students about the risks of unethical behavior (e.g., corruption), and teach them how to address such issues. The course also explores the ethical challenges posed by new technologies.

Recommended Prerequisites:

Ethics and deontology (the foundations)

Course Content:

A. Compliance with the rules of ethics and integrity,

1. **Reminder of the MESRS Charter of Ethics and Professional Conduct:** Integrity and honesty. Academic freedom. Mutual respect. Demand for scientific truth, Objectivity and critical thinking. Fairness. Rights and obligations of students, instructors, administrative and technical staff,

2. Integrity and Responsibility in Research

- Respect for ethical principles in teaching and research
- Responsibilities in teamwork: Professional equality of treatment. Conduct against discrimination. Pursuit of the public interest. Inappropriate conduct in collective work
- Adopting responsible conduct and combating abuses: Adopting responsible conduct in research. Scientific fraud. Conduct against fraud. Plagiarism (definition of plagiarism, different forms of plagiarism, procedures to avoid involuntary plagiarism, detection of plagiarism, sanctions against plagiarists, etc.). Falsification and fabrication of data.

3. **Ethics and Professional Conduct in the Workplace:**

Legal Confidentiality in Business. Loyalty to the Company. Responsibility within the Company. Conflicts of Interest. Integrity (Corruption in the Workplace, Its Forms, Consequences, Methods of Combating and Sanctioning Corruption).

B- Intellectual Property

I- Fundamentals of Intellectual Property

1- Industrial Property. Literary and Artistic Property.

2- Rules for Citation of References (Books, Scientific Articles, Conference Papers, Theses, Dissertations, etc.)

II- Copyright

1. **Copyright in the Digital Environment**

Introduction. Database copyright, software copyright. Specific case of open-source software.

2. Copyright in the Internet and E-Commerce

Domain name law. Intellectual property on the Internet. E-commerce website law. Intellectual property and social networks.

3. Patent

Definition. Rights in a patent. Usefulness of a patent. Patentability. Patent applications in Algeria and around the world.

III- Protection and Promotion of Intellectual Property

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

C. Ethics, Sustainable Development, and New Technologies

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

Assessment Method:

Exam: 100 %

References:

1. Charter of University Ethics and Professional Conduct, https://www.mesrs.dz/documents/12221/26200/Charte+fran_ais+d_f.pdf/50d6de61-aabd-4829-84b3-8302b790bdce
2. Order No. 933 of July 28, 2016, establishing the rules for preventing and combating plagiarism
3. The ABCs of Copyright, United Nations Educational, Scientific, and Cultural Organization (UNESCO)
4. E. Prairat, On Teaching Ethics. Paris, PUF, 2009.
5. Racine L., Legault G. A., Bégin L., Ethics and Engineering, Montreal, McGraw Hill, 1991.
6. Siroux D., Deontology: A Dictionary of Ethics and Moral Philosophy, Paris, Quadrige, 2004, pp. 474-477.
7. Medina Y., Ethics: What Will Change in Business, Editions d'Organisation, 2003.
8. Didier Ch., Thinking about the Ethics of Engineers, Presses Universitaires de France, 2008.
9. Gavarini L. and Ottavi D., Editorial on Professional Ethics in Training and Research, Research and Training, 52 | 2006, 5-11.
10. Caré C., Morality, Ethics, Deontology. Administration and Education, 2nd Quarter 2002, No. 94.
11. Jacquet-Francillon, François. Concept: Professional Ethics. Letélémaque, May 2000, No. 17.
12. Carr, D. Professionalism and Ethics in Teaching. New York, NY. Routledge. 2000.
13. Galloux, J.C., Industrial Property Law. Dalloz 2003.
14. Wagret, F. and J-M., Patents, Trademarks, and Industrial Property. PUF 2001.
15. Dekermadec, Y., Innovating Through Patents: A Revolution with the Internet. Insep 1999.
16. AEUTBM. The Engineer at the Heart of Innovation. Belfort-Montbéliard University of Technology
17. Fanny Rinck etléda Mansour, Literacy in the Digital Age: Copy-Paste Among Students, Grenoble 3 University and Paris-Ouest Nanterre La Défense University, Nanterre, France
18. Didier DUGUEST IEMN, Citing Sources, IAE Nantes 2008
19. Similarity Detection Software: A Solution to Electronic Plagiarism? Report of the Working Group on Electronic Plagiarism presented to the CREPUQ Subcommittee on Pedagogy and ICT
20. Emanuela Chiriac, Monique Filiatrault, and André Régimbald, Student Guide: Intellectual Integrity, Plagiarism, Cheating, and Fraud... Avoiding Them and, Above All, How to Properly Cite Your Sources, 2014.

21. University of Montreal Publication, Plagiarism Prevention Strategies, Integrity, Fraud, and Plagiarism, 2010.
22. Pierrick Malissard, Intellectual Property: Origin and Evolution, 2010.
23. The World Intellectual Property Organization website: www.wipo.int
24. http://www.app.asso.fr/

III. Detailed Course Program for Semester S3

Semester: 3
Teaching Unit: CUF 2.1.1
Course Title: Dynamics of Geotechnical Structures
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To introduce students to the dynamic analysis of geotechnical structures and their interaction with their environment.

Recommended Prerequisites:

Advanced Soil Mechanics, Foundations, Soil Dynamics, Slopes and Retaining Structures.

Course Content:

Chapter 1.	General concepts of soil-structure interaction	**(1 week)**
Chapter 2.	Behaviour of foundations under vibrating machines	**(4 weeks)**
Chapter 3.	Seismic bearing capacity of foundations	**(4 weeks)**
Chapter 4.	Seismic stability of retaining structures	**(3 weeks)**
Chapter 5.	Seismic stability of slopes and embankments	**(3 weeks)**

Assessment Method:

Continuous Assessment: 40%; Final Exam: 60%

References:

1. *A. Bouafia. Introduction to Soil Dynamics, Vols. 1 & 2, OPU, Algeria*
2. *A. Pecker. Soil Dynamics, Presses des Ponts, France*
3. *B.M. Das, G.V. Ramana. Principles of Soil Dynamics, Cengage Learning, USA*
4. *Fundamentals of Soil Dynamics, Elsevier*
5. *Shamsher Prakash. Soil Dynamics, McGraw-Hill*
6. *S.L. Kramer. Geotechnical Earthquake Engineering, Prentice Hall, USA*

Semester: 3
Teaching Unit: CUF 2.1.1
Course Title: Limit Analysis and Yield Design
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To introduce students to the theoretical foundations of limit analysis for structures and geotechnical works, and their practical applications.

Recommended Prerequisites:

Continuum Mechanics, Mechanics of Deformable Solids and Soil Mechanics.

Course Content:

Chapter 1. Concept of ultimate loads and common failure criteria **(3 weeks)**

Chapter 2. Static (internal) approach **(3 weeks)**

Chapter 3. Kinematic (external) approach **(3 weeks)**

Chapter 4. Practical applications **(6 weeks)**

- Structural elements: beams, frames, thin plates, slabs
- Geotechnical works: excavation stability, earth pressures, foundation bearing capacity

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *J. Salençon. Limit Analysis and Yield Design, Presses des Ponts, France*
2. *J. Salençon. Yield Design, Wiley-ISTE*
3. *P. De Buhan. Plasticity and Limit Analysis, Presses des Ponts*
4. *J. Lemaitre, J.L. Chaboche. Mechanics of Deformable and Damaged Solids, Dunod*
5. *J. Lemaitre, J.L. Chaboche, A. Benallal, R. Desmorat. Mechanics of Solid Materials, Dunod*

Semester: 3
Teaching Unit: CUF 2.1.2
Course Title: Rock Mechanics
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

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, Continuum Mechanics, Foundations and Geotechnical Structures.

Course Content:

Chapter 1. General concepts on rocks and rock masses **(4 weeks)**
(Rock formation processes, physical and thermal properties — Rock mass discontinuities: typology, description, geometric representation of joints — Rock and rock mass classification)

Chapter 2. Mechanical behaviour of rocks and rock masses **(6 weeks)**
(In-situ and laboratory characterization — Rock matrix: mechanical properties, strength criteria and failure modes — Discontinuities: characteristics and joint strength, seepage in joints — Rock masses: RQD/RMR/Q/QS/GSI classification)

Chapter 3. Stability of rock slopes **(3 weeks)**
(Rock slope failure modes, water's role, limit equilibrium stability, wedge failure, stabilization techniques)

Chapter 4. Stability of underground rock cavities **(2 weeks)**
(Stress states, design methods, stratified rock mass cases, swelling pressure calculations on linings)

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *J.L. Durville. Rock Mechanics: General Concepts (C350), Techniques de l'Ingénieur*
2. *J.L. Durville, H. Héraud. Rock and Rock Mass Description (C352), Techniques de l'Ingénieur*
3. *P. Duffaut, F. Homand. Manual of Rock Mechanics, Volumes 1 & 2, Presses des Ponts*
4. *R.E. Goodman. Introduction to Rock Mechanics, John Wiley & Sons*
5. *E. Hoek. Practical Rock Engineering*

Semester: 3
Teaching Unit: CUF 2.1.2
Course Title: Tunnels and Underground Structures
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To introduce students to the principles of design and dimensioning of tunnels and underground structures in both soil and rock.

Recommended Prerequisites:

Soil Mechanics 1 & 2, Rock Mechanics, Foundations and Geotechnical Structures.

Course Content:

Chapter 1.	Overview of underground structures	**(2 weeks)**
Chapter 2.	Tunnel Design and Construction Techniques	**(3 weeks)**
Chapter 3.	Tunnel Calculation and Sizing Methods	**(4 weeks)**
Chapter 4.	Tunnel Pathology and Reinforcement Techniques	**(2 weeks)**
Chapter 5.	Practical Application (Road or Rail Tunnel Calculation)	**(4 weeks)**

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References:

1. *M. Panet. Tunnel Design Using the Convergence-Confinement Method. Published by Presses des ponts, France.*
2. *A. Bouvard-Lecouanet, G. Colombet, F. Esteulle. Underground Structures: Design – Construction – Maintenance. Published by Presses des ponts, France.*
3. *L. Vulliet, L. Laloui, J. Zhao. Soil and Rock Mechanics. Published by Presses polytechniques et universitaires romandes.*
4. *F. Martin. Rock Mechanics and Underground Works: Course and Corrected Exercises. Published by BG Ingénieurs Conseils, ENS Cachan, France.*

Semester: 3
Teaching Unit: UEF 2.1.3
Course Title: Road Geotechnics
Total Hours: 45h00 (Lecture: 1h30/week)
Credits: 2
Coefficient: 1

Course Objectives:

To train students in conducting geotechnical studies for the design of road and highway pavements.

Recommended Prerequisites:

Soil Mechanics

Course Content:

Chapter 1.	Soil classification according to the GTR (Guide des Terrassements Routiers)	**(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)**

Suggested Detailed Syllabus

Part I: Introduction to roads **(3weeks)**

1- Road concepts
2- Types of pavements
3- Composition of flexible pavements
4- Road materials

Part II: Pavement design (**3 weeks)**

1- Pavement design definition
2- CBR method
3- Improved CBR method

Part III: Road earthworks **(3 weeks)**

1- Earthwork volume calculations
2- Volume measurement
3- Earth moving

Part IV: GTR soil classification **(3 weeks)**

1- Definitions
2- Soil classification system
3- Classification parameters
4- GTR classification table

Part V: Soil compaction **(3 weeks)**

Assessment Method:

Exam : 100%

References:

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

Semester: 3
Teaching Unit: CUM 2.1
Course Title: Ground Improvement
Total Hours: 45h00 (Lecture: 1h30/week, Tutorial: 1h30/week)
Credits: 4
Coefficient: 2

Course Objectives:

To present the theoretical and practical principles of soil improvement techniques used in geotechnical engineering.

Recommended Prerequisites:

Soil Mechanics, Foundations, Experimental Methods and Soil Rheology.

Course Content:

1. General Information on the Stabilization, Reinforcement, and Repair of Geotechnical Structures.
2. Chemical Soil Stabilization (Hydraulic Binder Treatment).
3. Reinforcement of Geotechnical Structures (Preloading, Retaining, Nailing, Reinforced Earth, Geotextiles, Stone Columns, Injections (Jet Grouting, Soil Mixing, etc.), Dynamic Compaction).
4. Method Selection Criteria

Practical Work Program:

PW N° 1 : Atterberg Limits of Reinforced Soils.
PW N° 2 : Proctor Test of Reinforced Soils.
PW N° 3 : CBR Test of Reinforced Soils.
PW N° 4 : Simple Compression Test of Reinforced Soils.
PW N° 5 : Simple Box Shear Test of Reinforced Soils.
PW N° 6 : Triaxial Shear Test of Reinforced Soils.
PW N° 7 : Soil-Fiber Shear Test.
PW N° 8 : Soil-Geotextile Shear Test.

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

References

1. Bell F. G., (1993): Engineering Treatment of Soils. E & FN Spon. 302 p.
2. GTS, Technical Guide (2000): "Soil Treatment with Lime and/or Hydraulic Binders. Application to the Construction of Embankments and Subgrades," LCPC-SETRA (Paris-Bagneux), January 2000, 240 p.
3. Mouroux P. et al. (1989) "Economic Construction on Expansive Soils." Manuals and Methods, BRGM, France.

4. Routes (2004); Soil Treatment with Lime and/or Hydraulic Binders for the Construction of Embankments and Subgrades. Technical Document, Routes No. 89, September 2004, Paris, France.
5. Davidovici, V. and Lambert, S. (2013). Foundations and Ground Improvement Processes, Application Guide for Earthquake-Resistant EC8: Ground Reinforcement Arrangements with Stone Columns in Seismic Zones, AFPS (2012). s.l.: Eyrolles, 2013. ISBN: 978-2-212-13831-3.
6. Dhouib, A., Magnan J.P., and Guilloux, A. (2004c). Investigation Methods and Application to Soils and Improvement Techniques. Proceedings of the International Symposium on In-Place Soil Improvement (ASEP-GI 2004). Presses de l'ENPC-LCPC, 2004c, Vol. 2.
7. Dhouib, A., and Blondeau, F. (2005). Stone Columns: Implementation Techniques, Areas of Application, Behavior, Justification, Control, and Areas of Research and Development. Presses de l'Ecole Nationale des Ponts et Chaussées - ISBN 2-85978-401-2, 2005 (ENPC), Paris.
8. Schlosser S. and Unterreiner P.: Soil Reinforcement by Inclusions. Engineering Techniques, C245.
9. AFPS Technical Guide (2012): Soil Improvement and Reinforcement Procedures Under Seismic Actions - Presse de Pont, Paris, 231 pages.
10. Magnan J. P. (1983): Theory and Practice of Vertical Drains. Technical and Documentation Edition - Lavoisier, Paris.
11. Queyroi D., Chaput D., Pilot G. (1985): Foundation Soil Improvement, Selection of Execution Methods. Technical Information Note from the Ministry of Urban Planning, Housing and Transport. LCPC Editions - 53p.
12. Technical Guide: Recommendations for the Detailed Inspection, Monitoring, and Diagnosis of Geosynthetic Reinforced Embankment Walls. Central Laboratory of Bridges and Roads, July 2003.
13. Holtz, R. D. (2001): Geosyntetic for Soil Reinforcement, The Ninth Spencer J. Buchanan Lecture, College Station, University Drive
14. Retaining Structures: General Design Guide. SETRA- Technical Studies Department for Roads and Highways - December 1998.
15. Reinforced Earth Structures (1979): Recommendations and Standards of the Art. LCPC-SETRA Document (1979).
16. Clouterre Recommendations (1991) for the Design, Calculation, Execution, and Inspection of Retaining Structures Constructed by Soil Nailing. Presses de l'ENPC, 1991, Paris.
17. Le-Kouby A.,: Reinforcement of dikes using the DeepSoilMixing technique. Summary of test results from experimental sites in Val d'Orléans. IFSTTAR – GERS – Soils, Rocks and Geotechnical Structures Laboratory – November 19, 2014.
18. Corté J-F., Poupelloz B., and Washkowski E., (1984): Reinforcement by injection of foundations for civil engineering structures. Report from the LCPC laboratories, May 1984.

Semester: 3
Teaching Unit: CUM 2.1
Course Title: Modelling of Geotechnical Structures
Total Hours: 22h30 (Practical Work: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:

Acquire practical skills for the design of foundations, retaining structures, and protection works using one of the following software: Plaxis, Geo5, Flac, Z-SOIL, COMSOL, etc....

Recommended Prerequisites:

Soil Mechanics, Geotechnical Testing 1 & 2 and Finite Element Method (FEM), ….

Course Content:
(To be detailed according to the program structure.)

Assessment Method:

Continuous Assessment: 100%

References:

User manual of the software selected for the practical sessions.

Semester: S3
Course Unit: CUM2.1
Subject 3: Geographic Information Systems
VHS: 37.5 hours (Lecture: 1.5 hours, Practical: 1 hour)
Credits: 3
Coefficient: 2

Course Objectives:

The purpose of this course is to familiarize students with geographic information systems and their application to geotechnical engineering.

Recommended Prerequisites:

Topography, Computer Science, Mathematics

Course Content:

Chapter 1. General Overview of Geographical Information Systems (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. Processing and Analysis in GIS **(3 weeks)**

Practical Work Program (Lab Sessions):
PW 1: Components of a GIS
Conception de base d'un SIG, Présentation du logiciel SIG
PW 2: Methods of Representing Geographic Data in a GIS
Vector model, Raster model, Digital Elevation Model (DEM)
PW 3: Data Import and Display
Data georeferencing, Projection systems.
PW 4: Data Management in GIS
Attribute data, Spatial data
PW 5 : Applications
Spatial analysis

Assessment Method:

Continuous Assessment: 40 % ; Exam: 60 %.

References:

1. Pornon, Henri. GIS: The Geographic Dimension of Information Systems. Dunod, 2015.
2. Chang, Kang-Tsung. Introduction to Geographic Information Systems. Boston: McGraw-Hill, 2008.
3. Denègre, Jean and Salgé, François. Introduction to Geographic Information Systems. Que sais-je?, 2004, vol. 2, no 3122, pp. 5-11.
4. GIS software user guides.

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Semester: 3
Teaching Unit: CUT 2.1
Course: Documentary Research and Dissertation Design
Total Hours: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
Provide students with the necessary tools to search for relevant information and effectively use it in their final year project. Assist them in navigating the various stages leading to the writing of a scientific document. Emphasize the importance of communication and train them to rigorously and pedagogically present their work.

Recommended Prerequisite:
Writing Methodology and Presentation Methodology.

Course Content:

Part I: Documentary Research:

Chapter I-1: Defining the Topic (02 weeks)
- Title of the topic
- List of keywords related to the topic
- Gather basic information (acquiring specialized vocabulary, meaning of terms, linguistic definitions)
- Targeted information
- Review existing knowledge in the field

Chapter I-2: Selecting Information Sources (02 weeks)
- Types of documents (Books, Theses, Dissertations, Journal articles, Conference proceedings, Audiovisual materials…)
- Types of resources (Libraries, Internet…)
- Assessing the quality and relevance of information sources

Chapter I-3: Locating Documents (01 week)
- Search techniques
- Search operators

Chapter I-4: Processing Information (02 weeks)
- Organizing the work
- Initial research questions
- Synthesizing selected documents
- Linking different sections
- Final outline of the documentary research

Chapter I-5: Bibliography Presentation (01 week)
- Bibliographic presentation systems (Harvard, Vancouver, Mixed…)
- Document presentation
- Citing sources

Part II: Dissertation Design
Chapter II-1: Dissertation Plan and Stages (02 weeks)

- Identify and narrow down the topic (Summary)
- Research problem and dissertation objectives
- Other useful sections (Acknowledgments, Abbreviations list…)
- Introduction (written last)
- Review of specialized literature
- Hypotheses formulation
- Methodology
- Results
- Discussion
- Recommendations
- Conclusion and future outlook
- Table of contents
- Bibliography
- Appendices

Chapter II-2: Writing Techniques and Standards **(02 weeks)**

- Formatting. Numbering chapters, figures, and tables
- Title page
- Typography and punctuation
- Scientific writing: style, grammar, syntax
- Spelling. Improving general language skills for comprehension and expression
- Saving, securing, and archiving data

Chapter II-3: Workshop: Critical Review of a Manuscript **(01 week)**

Chapter II-4: Oral Presentations and Defenses **(01 week)**

- How to present a Poster
- How to deliver an oral presentation
- Dissertation defense

Chapter II-5: How to Avoid Plagiarism? **(01 week)**

(Quotations, phrases, illustrations, graphs, data, statistics, etc.)

- Citing sources
- Paraphrasing
- Providing complete bibliographic references

Assessment Method:

Exam : 100%

References :

1. *M. Griselin et al., Guide to Written Communication, 2nd edition, Dunod, 1999.*
2. *J.L. Lebrun, Practical Guide to Scientific Writing: How to Write for the International Scientific Reader, Les Ulis, EDP Sciences, 2007.*
3. *A. Mallender Tanner, The ABCs of Technical Writing: Instructions, User Guides, Online Help, Dunod, 2002.*
4. *M. Greuter, Writing Your Dissertation or Internship Report Well, L'Etudiant, 2007.*
5. *M. Boeglin, Reading and Writing at University. From the Chaos of Ideas to the Structured Text, L'Etudiant, 2005.*
6. *M. Beaud, The Art of the Thesis, Editions Casbah, 1999.*
7. *M. Beaud, The Art of the Thesis, La Découverte, 2003.*
8. *M. Kalika, The Master's Thesis, Dunod, 2005.*

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

Semester: X
Course Unit: CUD X.X
Subject: Hydrogeology
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

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

Recommended Prerequisite:

Geology, General Hydraulics, Soil Mechanics.

Course Content:

Chapter 1.	Behaviour of Aquifer Systems in Reservoirs	**(4 weeks)**
Chapter 2.	Behaviour of Aquifer Systems in Conduits	**(4 weeks)**
Chapter 3.	Flow Networks	**(4 weeks)**
Chapter 4.	Water Flow Control	**(3 weeks)**

Assessment Method:

Exam: 100%

Rdfdrences:

1. *E. Gilli. C. Mangan, J. Mudry. Hydrogeology: Objects, Methods, Applications. Dunod Publishing.*
2. *G. Castany. Hydrogeology: principles and methods. Ed. Dunod.*

Semester: X
Course Unit: CUD X.X
Subject: Geotechnical Hazards and Risks
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

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

Recommended Prerequisite:

Knowledge of probability and statistics, soil mechanics.

Course Content:

Chapter 1.	Introduction to Geotechnical Hazards	**(1 week)**
Chapter 2	General Hazards Analysis Methodology	**(4 weeks)**
Chapter 3.	Remote Sensing Applied to the Natural Environment	**(4 weeks)**
Chapter 4.	Data Analysis and Processing Methodology	**(4 weeks)**
Chapter 5.	Warning Systems and Crisis Management	**(2 weeks)**

Assessment Method:

Exam: 100%

References:

1. *M. Merad. Decision Support and Expertise in Risk Management. Lavoisier Publishing.*
2. *J.P. Louisot. Risk Management and Strategy. AFNOR Publishing.*
3. *J.L. Wybo. Risk Management and Crisis Prevention. Ed. Lavoisier.*
4. *Techniques and Methods: Shrinkage and Swelling: Analysis and Treatment of Disorders Produced by Drought. Guide 3, IFSTTAR Edition, July 2017.*
5. *Federal Roads Office OFROU: Risk Analysis for National Road Tunnels, ASTRA Edition; 2014.*
6. *Kergomard C.: Aerospace Remote Sensing: An Introduction. Course at the École Nationale Supérieure de Paris.*
7. *AFTES Recommendations: Characterization of Geological, Hydrogeological, and Geotechnical Uncertainties and Risks. GT32R2F1, July–August 2012.*
8. *Methodological Guide: Risk Management in Major Public Infrastructure Projects. Edition: Infrastructure Québec.*
9. *Engineering Techniques: "Safety and Risk Management" File. (www.techniques-ingénieur.fr/traite/securite_et_gestion_des_risques/T1112)*

Semester X
Course Unit: X.X
Subject: Finite Difference Method
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

This course introduces students to the design of geotechnical structures using the finite difference method.

Recommended Prerequisite:

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.	Discover of Some Cases studies	**(4 weeks)**

Practical works Program WP

Part 1 in Matlab (or other): Implementation of the finite difference method for a simple case (beam bending, consolidation problem).

Part 2: Use of DF software in geotechnics (Flac or other) and study of a practical case: Problem modelling, domain discretization, meshing, introduction of boundary and initial conditions, solution and analysis of results.

Assessment method:

Continuous assessment: 40%; Exam: 60%

References:

1. *A. Curnier. Numerical methods in solid mechanics. Published by Presses polytechniques et universitaires romandes.*
2. *M. Deville, M. Rappaz. Numerical modeling in materials science and engineering. Published by Presses polytechniques et universitaires romandes.*
3. *M. Rappaz, M. Bellet, M. Deville. Treatise on Materials 10. Published by Polytechnic and University Presses of Romandie.*
4. *G. Allaire. Numerical Analysis and Optimization: An Introduction to Modeling. Published by École Polytechnique, France.*

Semester: X
Course Unit: CUD X.X
Subject: Pathology of Geotechnical Structures
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

The purpose of this course is to introduce students to the main pathological cases related to geotechnical structures, their diagnostic techniques, and possible repair methods.

Recommended Prerequisite:

Soil Mechanics, Geology, Hydraulic, SSI

Course Content:

It covers the following points:

- Analysis of the causes of damage (construction errors, site instability, structural defects, changes in the characteristics of the foundation soil, environmental changes).
- Causes related to structures (constituent materials, undersizing, poor workmanship).
- Causes related to problematic soils (expansive soils, collapsible soils, and liquefiable soils).
- Pathologies of shallow and deep foundations.
- Pathologies of retaining structures.
- Means of prevention and repair of damaged structures.

Proposed new content:

- Definition of pathology and general information on the diagnosis and causes of pathologies,
- Pathologies of shallow and deep foundations,
- Pathology of retaining structures,
- Pathology of tunnels and underground structures,
- Pathology of drainage structures,
- Pathology of roads and highways,
- Means of prevention and repair of damaged structures.

Assessment Method:

Examen: 100%

References:

1. *M. Lor. (2015), Pathology, diagnosis, prevention and maintenance of structures (C7100 V1). Ed. Engineering Techniques.*
2. *J. Delefosse. Pathologies of reinforced concrete – Physicochemical actions, special cases and specific structures (C6200 V2). Ed. Engineering Techniques.*
3. *A. Plumier. (2011), Pathologies and structural repairs of buildings. Course at the University of Liège. 4. L. Logeais (2012), Foundation Pathology – Fondasol. Moniteur Edition.*
4. *Pathology of Shallow Foundations: Diagnosis, Repair, and Prevention – Single-Family Houses and Similar Buildings. CSTB Editions 2015.*
5. *Guide to Civil Engineering Inspection of Road Tunnels. From Disorder to Diagnosis – Book 1 – Disorder Catalog – Book 2 – CETU Guides – 2015.*

6. *Shrinkage and Swelling of Clay: Analysis and Treatment of Disorders Resulting from Drought. Techniques and Methods – Guide 3 – IFSTTAR Technical Guide 2017.*
7. *Repair and Reinforcement of Foundations. STRRES Guides No. 1 – National Federation of Public Works (FNTP).*
8. *M. Lor. Pathology, Diagnosis, Prevention, and Maintenance of Structures (C7100 V1). Engineering Techniques Ed.*
9. *J. Delefosse. Pathologies of Reinforced Concrete – Physicochemical Actions, Special Cases and Specific Structures (C6200 V2). Engineering Techniques Ed.*

Semester: X
Course Unit: CUD X.X
Subject: Public Procurement Code
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

Recommended Prerequisite:

Subject Content:

Assessment Method:

Exam: 100%

References:

Semester: X
Course Unit: CUD X.X
Subject: Geotechnical Standards
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

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

Recommended Prerequisite:

Soil Mechanics 1 and 2, Foundations and Geotechnical Structures.

Course Content:

It covers the following topics:

- Testing Standards: Experimental procedures and techniques for analyzing test results (in-situ and laboratory tests).
- Design and Calculation Standards (foundations, retaining structures, barriers, etc.). - Standards for the execution, monitoring, and inspection of geotechnical structures.
- Overview of European standards (Eurocode 7), American standards (ASTM: Geotechnical Engineering Standards), etc.

Assessment method:

Exam: 100%

References:

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

Semester: X
Course Unit: CUD X.X
Subject: Construction Law
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives::

Recommended Prerequisite:

Course Content:

Assessment Method:

Exam: 100%

References:

Semester: X
Course Unit: CUD X.X
Subject: General Construction Processes for Geotechnical Structures
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

This course introduces students to the general construction processes for foundations and geotechnical structures.

Recommended Prerequisites:

Soil Mechanics 1 and 2, Foundations and Geotechnical Structures.

Course Content:

It covers the following topics:

- Design.
- Regulatory Principles of Design.
- Construction Techniques.

Assessment Method:

Exam: 100%

References:

Any document dealing with geotechnical structures.

Semester: X
Course Unit: CUD X.X
Subject: Basics of Civil and Industrial Construction
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

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

Recommended Prerequisites:

Construction Materials, Strength of Materials, Reinforced Concrete, Steel Structures.

Course Content:

It covers the following topics:

- Design.
- Regulatory Principles of Design.
- Construction Techniques.

Assessment Method:

Exam: 100%

References:

Any document dealing with civil and industrial construction

Semester: X
Course Unit: CUD X.X
Subject: Basics of Roads and Civil Engineering Structures
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

This course introduces students to roads and civil engineering structures.

Recommended Prerequisites:

Construction Materials, Strength of Materials, Reinforced Concrete, Steel Structures.

Course Content:

It covers the following topics:

- Design.
- Regulatory Principles of Design.
- Construction Techniques.

Assessment Method:

Exam: 100%

References :

Any document relating to roads and civil engineering structures

Semester: X
Course Unit: CUD X.X
Subject: Basics of Hydrotechnical Structures
VHS: 22:30 (Lecture: 1:30)
Credits: 1
Coefficient: 1

Course Objectives:

This course introduces students to hydrotechnical structures.

Recommended Prerequisites:

Construction Materials, Strength of Materials, Reinforced Concrete, Steel Structures.

Course Content:

It covers the following topics:

- Design.
- Regulatory Principles of Design.
- Construction Techniques.

Suggested Course Content

Part I: Retaining Structures

1- General Information on Dams
- Definition of a Dam
- Buts d'un barrage
- Structures Constituting a Dam
- Types of Dams

2- Choosing a Dam Site
- Topography
- Hydrology
- Geotechnics

3- Calculation of RCC Gravity Dams
- Forces Applied to the Dam
- Overturning Stability
- Sliding Stability
- Drainage of RCC Dams

Assessement Method :

Exam: 100%

References:

Any document dealing with hydrotechnical structures.