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 Educational Committee for the field of Science and Technology

ACADEMIC MASTER HARMONIZED

National program

2022 update

Domain	Sector	Speciality
Science And Technologies	***Public Works***	***Roads and Works of Art***

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National Educational Committee for the field of Science and Technology

مواءمة
ماستر أكاديمي

تحيين 2022

الميدان	الفرع	التخصص
علوم و تكنولوجيا	أشغال عمومية	طرقات ومنشآت فنية

I–Master's identity sheet

Access conditions

Sector	Harmonized Master	Access licenses to the master's degree	Ranking according to license compatibility	Coefficient assigned to the license
Public works	Roads and Works of Art	Public works	**1**	**1.00**
		Civil engineering	**1**	**1.00**
		Hydraulic	**2**	**0.70**
		Mechanical construction	**2**	**0.70**
		Other licenses in the ST domain	**5**	**0.60**

II – Half-yearly teaching organization sheets of the specialty

Semester 1 Master: Roads and Art Works

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titles			**Course**	**TUTO**	**PW**			**Continuous monitoring**	**Exam**
Fundamental TU Code: FTU 1.1.1 Credits: 8 Coefficients: 4	Elasticity Theory	4	2	1h30	1h30		45h00	55h00	40%	60%
	Dynamics of structures	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code: FTU 1.1.2 Credits: 10 Coefficients: 5	Dimensioning of Bridges	6	3	3h00	1h30		67h30	82h30	40%	60%
	Road Dimensioning	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Code: MTU 1.1 Credits: 9 Coefficients: 5	Reinforced Concrete Structures Project	5	3	1h30	1h30	1h00	60h00	65h00	40%	60%
	PW Programming	2	1			1h30	22h30	27h30	100%	
	PW Software Applied to Roads	2	1			1h30	22h30	27h30	100%	
TU Discovery Code: DTU 1.1 Credits: 2 Coefficients: 2	*Material of your choice*	1	1	1h30			22h30	02h30		100%
	Material of your choice	1	1	1h30			22h30	02h30		100%
Transversal TU Code: TTU 1.1 Credits: 1 Coefficients: 1	Technical English and terminology	1	1	1h30			22h30	02h30		100%
Total semester 1		**30**	**17**	**13h30**	**7h30**	**4h00**	**375h00**	**375h00**		

Semester 2 Master: Roads and Art Works

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titles			**Course**	**TUTO**	**PW**			**Continuous monitoring**	**Exam**
Fundamental TU Code: FTU 1.2.1 Credits: 8 Coefficients: 4	Plasticity Theory	4	2	1h30	1h30		45h00	55h00	40%	60%
	Dimensioning of Bridges 2	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code: FTU 1.2.2 Credits: 10 Coefficients 5	Prestressed concrete	6	3	3h00	1h30		67h30	82h30	40%	60%
	Metal constructions	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Code: MTU 1.2 Credits: 9 Coefficients: 5	Finite element methods	4	2	1h30	1h30		45h00	55h00	40%	60%
	Roads project	3	2	1h30		1h00	37h30	37h30	40%	60%
	Practical work in Geographic Information Systems (GIS)	2	1			1h30	22h30	27h30	100%	
TU Discovery Code: DTU 1.2 Credits: 2 Coefficients: 2	*Material of your choice*	1	1	1h30			22h30	02h30		100%
	Material of your choice	1	1	1h30			22h30	02h30		100%
Transversal TU Code: TTU 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	7h30	2h30	**375h00**	**375h00**		

Semester 3 Masterh Roads and Art Works

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titles			**Course**	**TUTO**	**PW**			**Continuous monitoring**	**Exam**
Fundamental TU Code: FTU 2.1.1 Credits: 8 Coefficients: 4	Advanced Bridge Designs	4	2	1h30	1h30		45h00	55h00	40%	60%
	Underground works	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code: FTU 2.1.2 Credits: 10 Coefficients: 5	Railroads	4	2	1h30	1h30		45h00	55h00	40%	60%
	Aerodromes	4	2	1h30	1h30		45h00	55h00	40%	60%
	Pathology and rehabilitation of Art Works	2	1	1h30			22h30	27h30		100%
Methodological TU Code: MTU 2.1 Credits: 9 Coefficients: 5	Advanced geotechnics	4	2	1h30		1h30	45h00	55h00	40%	60%
	Numerical Modeling of Bridges	3	2			2h30	37h30	37h30	100%	
	Organization and visits of sites	2	1			1h30	22h30	27h30	100%	
TU Discovery Code: DTU 2.1 Credits:2 Coefficients: 2	*Material of your choice*	1	1	1h30			22h30	02h30		100%
	Material of your choice	1	1	1h30			22h30	02h30		100%
Transversal TU Code: TTU 2.1 Credits: 1 Coefficients: 1	Documentary research and dissertation design	1	1	1h30			10h30 p.m.	02h30		100%
Total semester 3		**30**	**17**	13h30	6h00	5h30	**375h00**	**375h00**		

Discovery Unit (S1, S2, S3)

Discovery Unit (S1, S2 and S3)

1. Territorial planning and infrastructure
2. Hydraulic arrangements
3. Dams
4. Markets Code and legislation
5. Secondary States Corps
6. Transport economics
7. Geniusseismic
8. Geology
9. Road geotechnics
10. Risk management
11. General hydraulics
12. Hydrology
13. Project management
14. Rock mechanics
15. Ground Mecanic
16. Experimental methods
17. Quantity and quote
18. Maritime works
19. Pavement pathologies
20. Transportation planning and systems
21. Road safety 1
22. Road Safety 2
23. Traffic techniques
24. Urban planning
25. Various roads and networks

Semester 4

Internship in a company or in a research laboratory culminating in a dissertation and a defense.

	SHV	coefficient	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 given for information purposes only.

Evaluation of the End of Master Cycle Project

- Scientific value (jury assessment) /6
- Writing of the dissertation (jury assessment) /4
- Presentation and response to questions (Jury assessment) /4
- Appreciation of the supervisor /3
- Presentation of the internship report (Jury assessment) /3

III - Detailed program by subject for the S1 semester

Semester 1
Teaching unit: FTU 1.1.1
Subject: Theory of Elasticity
SHV: 45h00 (class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Present in detail the concepts of stresses and strains followed by behavioral relationships in the field of elastostatics. An overview of the different notions of energy will also be discussed.

Recommended prior knowledge:

Basic math tools and SOM.

Content of the material:

Chapter 1: General information on the mechanics of continuous media (MMC).(2 weeks)

Theory of elasticity with respect to MMC, SOM.
Basic assumptions of elasticity theory.

Chapter 2:Tensor notations (2 weeks)

Vectors and tensors (Notations, Change of reference
Permutations and determiners (Permutation symbols,
Determinant of a matrix, Characteristic polynomial
Vector calculation and vector analysis
Curvilinear coordinates (cylindrical and spherical, etc.)

Chapter 3: Stress state theory (3 weeks)

Reminders on the concept of stress - Stress tensor.
Differential equations of equilibrium in Cartesian coordinates.
Study of the stress tensor at a point.
Expressions of differential equations in cylindrical coordinates.
Boundary conditions or boundary conditions.

Chapter 4: Strain state theory. (4 weeks)

Kinematic description (Lagrangian and Eulerian)
Relations between deformations and displacements (small and large displacements)
(Study of the tensor linearized at a point, Special case of plane deformation.
Deformation compatibility equations in small displacements.
Relations between deformations and displacements in cylindrical coordinates.

Chapter 5: Relationships between stresses and strains. **(2 weeks)**

General. Case of a linear elastic body.
Anisotropy, elastic symmetry, isotropy.
Generalized Hooke's law.
Influence of temperature.
Rheological models.

Chapter 6: Classical formulation of problems in linear elasticity(2 weeks)

General. Type I, II and III problems.
Principles of superposition, uniqueness of the St Venant solution.

Principles of energy conservation.
General equations of elasticity (Solutions according to displacements:
Lamé equations, Solutions depending on constraints: Beltrami-Mitchell equations.

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references

1. *Mechanics of continuous media - Elasticity and curvilinear media, Jean Salençon, Ecole Polytechnique X, Ellipses Editions*
2. *Theory of elasticity, SP Timoshenko, JN Goodier, Mc Graw Hill editions*
3. *Elasticity course, JP Henry, F. Parsy, Dunod University Edition*
4. *Theory of elasticity E.Green and W.Zerna*
5. *Theory of Elasticity, third edition, SPTimoshenko*
6. *Mathematical elasticity AELove*
7. *Soliman BELKAHLA "ELASTICITY – PLASTICITY COURSE"*
8. *Introduction to continuum mechanics, Malvern*
9. *Continuum mechanics, G. Mase*
10. *Francois Frey "Analysis of continuous structures and environments".*
11. *Mechanics of continuous media Volume 3 Plates and shells*

Semester 1

Teaching unit: FTU 1.1.1
Matter :Dynamics of structures
SHV: 45h00 (class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Present a treatment of the modern theory of calculation of structures subjected to dynamic and smake the student aware of the vibration problems of simple systems with one or more degrees of freedom.

Recommended prior knowledge:

Basic mathematical tools and the laws of strength of materials.

Content of the material:

Chapter 1 : Behaviorstructural dynamics **(5 weeks)**
Mathematical models and degrees of freedom
Mathematical models
Dynamic response

Chapter 2: Systems with one degree of freedom **(5 weeks)**
Formulation of the equation of motion
(Modeling, Principle of virtual works, Hamilton principle)
Vibration of systems with one degree of freedom:
(Free undamped vibrations, Free damped vibrations,
Harmonic excitation, periodic, special and general excitations)

Chapter 3: Systems with several degrees of freedom **(5 weeks)**
Discretization and modeling
Development of matrices K, C and M (discrete systems, continuous systems
Natural frequencies, natural modes (Rigidity matrix method, Flexibility method method,
Approximate methods for the evaluation of natural frequencies and modes
Systems with distributed characteristics (Beam bending, Free vibration
Forced vibration of systems with several degrees of freedom (Modal superposition method, Step-by-step integration method

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references

1. *Dynamics of structure, Clough, Computers and Structures, 1980.*
2. *Dynamics of structures in engineering seismology, Lucia Dobrescu, 1983.*
3. *Structural Dynamics – Fundamental Principles, RW Clough & J. Penzien Pluralis Editions.*
4. *Dynamic calculation of structures in seismic zones, A. Capra & V. Davidovici, Eyrolles editions.*

Semester 1
Teaching unit: FTU 1.1.2
Matter :Bridge Dimensioning
SHV: 67h30 (class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:
The student will be able to dimension the decks of common bridges and the various bridge equipment.

Recommended prior knowledge:
Knowledge acquired in license in Bridge 1, SOM, Road 1 and 2, SM, RPOA regulations.

Content of the material:

Chapter 1 : General and Reminders **(2 weeks)**
Constitutive elements of bridges.
Actions and requests on bridges.
Types of bridges
Chapter 2 : Lines of influence theory **(3 weeks)**
Lines of influence for an isostatic, truss beam
and hyperstatic beam
Chapter 3: Calculation of bridge slabs **(2 weeks)**
Chapter 4: Calculation of beams with assumed braces **(2 weeks)**
Infinitely rigid. Courbons method
Chapter 5: Calculation of beams with spacers of finite stiffness. **(2 weeks)**
Guyon Massonnet method
Chapter 6: Bridge equipment **(2 weeks)**
Dimensioning of support devices and seismic couplings
Dimensioning of road joints.
Security fence
Chapter 7: Calculation of supports. **(2 weeks)**
Calculation of piers and abutments.

Evaluation method:
Continuous Control: 40%; Exam: 60%

Bibliographic references

1. *Project and construction of bridges, Structural analysis of bridge decks, volume 2 by CALGARO JM*
2. *Thin-walled beams by CALGARO by JM*
3. *Theory of box girders by V. KISTEK*
4. *Bridge decks by B. GREZES and by P. LECROQ.*

Semester 1
Teaching unit: FTU 1.1.2
Matter: Dimensioning of Roads
SHV: 45h00 (class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

This course aims to define all the elements and characteristics necessary for the geometric design and Dimensioning of roads taking into account the adaptation of the road to traffic needs.

Recommended prior knowledge:

Soil mechanics, roads, drawing, topography.

Content of the material:

Chapter 1: General information and reminders **(2 weeks)**

- General notions of road infrastructure;
- Traffic analysis;
- Road classification;
- Geometric characteristics of roads.

Chapter 2: Designand calculation of road infrastructure **(3 weeks)**

- Classification of traffic lanes with standards (B40 and B30)
- In-depth study of the geometric parameters of roads in plan
- In-depth study of the geometric parameters of the longitudinal profile
- Adaptation and coordination between the plan layout and the longitudinal profile
- Design and drawings of cross sections

Chapter 3: Roadways (1 Week)

- Definitions
- Pavement structure families and their operation
- Flexible pavements
- Rigid pavements
- Semi-rigid roadways
- Roles of the different layers of a flexible pavement

Chapter 4: Pavement mechanics models (2 Weeks)

- Boussinesq model
- Westergaard two-layer model
- Hogg's bilayer model
- Burmister model
- Jeuffroy model
- Finite element models

Chapter 5: Dimensioning of road pavements (3 weeks)

- Dimensioning methods (Theoretical, empirical and semi-empirical)
- Fundamental parameters for Dimensioning studies
- CBR method modified according to TPL,CEBTP method, AASHTO Method and Shell Method
- Algerian method for Dimensioning new pavements (CTTP catalog)

- Calculation of admissible fatigue stresses during the lifespan of the road

Chapter 6: Development of intersections **(2 weeks)**

- Driver problem
- General principles of planning
- Classification of intersections
- Determination of geometric characteristics
- Projection methods

Chapter 7: The highways **(2 weeks)**

- General
- Geometric characteristics
- The exchangers
- Establishment of highway projects

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references:

1. *Roads,R.Coquand Eyrolles1985,*
2. *Roads and Airfields.PM-Clichy Beugnet1983*
3. *Communication routes, maritime works, roads.N.Bos*
4. *B 40 technical standards for road development*
5. *Technical guide for new roads (1994)*
6. *Pavement structure catalog RN (1998)*
7. *Low traffic roadway manual*
8. *Technical guide for concrete pavements (1997)*
9. *1. LCPC-SETRA. "Guide to road earthworks: Creation of embankments and subgrade layers". Technical guide, France, 2000.*
10. *LCPC-SETRA. "Treatment of soils with lime and/or hydraulic binders". Technical guide, France, 2000.*
11. *J. Costet, G.Sanglerat. "Practical course in soil mechanics". Dunod, 1981.S. Amar, J.-P. Magnan. "Soil mechanics tests in the laboratory and on site: Cheat sheet". LPC report, France, 1980.*
12. *F. Schlosser. "Elements of soil mechanics". Presses des Ponts, France, 1988. OPU Collections, Algeria.*

Semester 1
Teaching unit: MTU 1.1
Matter: Reinforced concrete structures project
SHV: 60h00 (Class: 1h30, TD: 1h30, PW: 1h00)
Credits: 5
Coefficient: 3

Teaching objectives:

The purpose of this course is to enable the student to conduct a study reinforced concrete works in the field of civil engineering (Calculation, Dimensioning, and verification).

Recommended prior knowledge:

Knowledge acquired during undergraduate training.

Content of the material:

Chapter 1:RC structural frames **(2 weeks)**
Design, Dimensioning, calculation and justifications
RC structural elements (posts, beams and sails)

Chapter 2 : Calculation of surface RC foundations **(3 weeks)**
Reminder on the connecting rod method;
Design, Dimensioning, calculation and justifications
(centered loading and eccentric loading) for:
isolated foundations, strip foundations and general foundations.

Chapter 3: Calculation of deep RC foundations **(3 weeks)**
Design, Dimensioning, calculation and justifications
footings on piles, piles.

Chapter 4: Design and calculation of retaining walls **(4 weeks)**
Design of retaining walls
Calculation of retaining walls without operating overload
Calculation of retaining walls with operating load

Chapter 5:Calculation of floors **(3 weeks)**
Solid slab floor, ribbed floor, Orthogonal beam floors, mushroom floors,prefabricated floor.

Practical work

Teaching objectives:

This practical work aims to introduce students to the different software used in the modeling of simple structures in civil engineering using software such as: Professional Robot Structural Analysis, SAP, ETABS or other. This step will make it easier for them to model the works of art later.

PW1: to the necessary documents (architectural plans, soil studies, etc.) and Software features.
PW2: Introduction to examples of simple structures
PW3: Introduction of different charges
PW4: Modeling and analysis of structures
PW5: Exploitation and interpretation of results
PW6: Working drawings and calculation notes.

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references

1. *Dimensioning of concrete structures: basics and technology, by René Walther & Manfred Miehlbradt, 1990.*
2. *Treatise on Reinforced Concrete, Volumes 1 to 12, F. Guerrin, Editions Eyrolls.*
3. *Treaty of Reinforced Concrete'; by R LACROIX, A.FUENTES and H THONIER; Editions Eyrolles, Paris.*
4. *Practice of BAEL; J.PERCHAT and J.ROUX; Editions Eyrolles, Paris.*
5. *PflugL. ,LestuzziP., Bar and beam structures, Analysis of continuous structures and environments – civil engineering treatise - Volume 4, 2014.*
6. *Software guides*

Semester1
Teaching unit: MTU 1.1
Matter: Programming
SHV: 22h30(PW:1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

The aim of this practical work is to introduce students to acquire a basis in direct calculation or programming, in order to solve the various problems which arise in structural mechanics.

Recommended prior knowledge:

Resistance of materials, Mechanics of continuous media, the basics of the energy formulation of structural mechanics, notion of solid mechanics, differential and matrix calculus, computer science.

Material content:

Under Matlab (or other):

PW1: Introduction to the software used (Matlab or other): Functions: syntax, global and local variables, saving a function, calling a function,
PW2: Operations on vectors and matrices, operation on polynomials,
PW3: 2D graphics, from points, or a function, 3D graphics: mesh, axes, visualization,
PW4: Character strings, file manipulation,
PW5: Applications in SOM: Calculation of forces and deformations in a simple and continuous beam under distributed and concentrated loads,
PW6: Reinforced concrete applications: Calculation for compressive, tensile and simple bending forces.

Evaluation mode:
Continuous control : 100%

Bibliographic references:

1. *Handout prepared by the teacher*
2. *Concepts in programming languages. JC Mitchel, Prentice Hall 1997*
3. *M. BOUMAHRAT, A. GOURDIN"Applied numerical methods" OPU 1993*
4. *VARGA "Matrix iterative analysis"Printice Hall, 1962*
5. *BESTOUGEFF "Computer technology: Digital and non-digital algorithms" Volume 2, Masson, 1975*
6. *Introduction to Matlab, JT Lapreste, Ellipse, 1999.*
7. *Mathematical tools for students with Matlab, JT Lapreste, Ellipse, 2008.*
8. *Matlab for engineers, A. Biran, Edition Pearson, 2004.*

Semester1
Teaching unit: MTU 1.1
Matter: PW Software Applied to Roads
SHV: 22h30(PW:1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

This PW aims to define all the elements and characteristics necessary for the geometric design of roads to develop a rational and economical road, to dimension and carry out the execution of a road.

Recommended prior knowledge:

Roads, Computer Science.

Material content:

- **PW 1** The calculation software environment applied to roads (Covadis or Piste)
- **PW 2** Interpolation of topographic points
- **PW 3** Drawings in Plan
- **PW 4** Long profile
- **PW 5** Cross Profile

Evaluation mode:

Continuous control: 100%

Bibliographic references:

1. *Handout prepared by the teacher*
2. *Concepts in programming languages. JC Mitchel, Prentice Hall 1997.*
3. *LCPC-SETRA. "Guide to road earthworks: Creation of embankments and subgrade layers". Technical guide, France, 2000.*
4. *Software Guide*

Semester: 1
Teaching unit: TTU 1.1
Subject 1:Technical English and terminology
SHV: 22h30 (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Introduce the student to technical vocabulary. Strengthen your knowledge of the language. Help him understand and synthesize a technical document. Allow him to understand a conversation in English held in a scientific framework.

Recommended prior knowledge:

Basic English vocabulary and grammar

Material content:

- Written comprehension :Reading and analysis of texts relating to the specialty.

- Oral comprehension: Based on authentic popular science video documents,note taking, summary and presentation of the document.

- Oral expression: Presentation of a scientific or technical subject,development and exchange of oral messages (ideas and data), Telephone communication, Gestural expression.

- Written expression :Extraction of ideas from a scientific document, Writing a scientific message, Exchange of information in writing,writing CVs, application letters for internships or jobs.

Recommendation : It is strongly recommended that the person responsible for the subject presents and explains at the end of each session (at most) around ten technical words of the specialty in the three languages (if possible) English, French and Arabic.

Evaluation method:

Review: 100%.

Bibliographic references:

1. *PT Danison, Practical guide to writing in English: uses and rules, practical advice, Editions d'Organization 2007*
2. *A. Chamberlain, R. Steele, Practical guide to communication: English, Didier 1992*
3. *R. Ernst, Dictionary of applied techniques and sciences: French-English, Dunod 2002.*
4. *J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980*
5. *EH Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995*
6. *TN Huckin, and AL Olsen, Technical writing and professional communication for nonnative speakers of English, McGraw-Hill 1991*
7. *J. Orasanu, Reading Comprehension from Research to Practice, Erlbaum Associates 1986*

IV - Detailed programs by subject for the S2 semester

Semester 2
Teaching unit: UEF1.2.1
Matter: Plasticity theory
SHV: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
This course aims to introduce the student to the theoretical notions of the theory of plasticity of structures.

Recommended prior knowledge:
Algebra, Mechanics of continuous media, Rational mechanics, Fluid mechanics, Resistance of materials

Chapter 1: Mechanical Tests(4 weeks)
Uniaxial mechanical tests, Creep, Tensile tests, Dynamic tests, Multiaxial tests, indentation, fatigue, resilience, toughness, Non-destructive testing.
Chapter 2: Rheological Models (3 weeks)
Perfect models, Elasticity, Viscoelasticity, Plasticity, Perfectly plastic rigid solid, Perfectly plastic linear elastic solid, Work hardenable elastoplastic solid, Viscoplasticity.

Chapter 3: Criteria Plasticity (3 Weeks)
Tresca criterion, von Mises criterion, Mohr-Coulomb criterion, Drucker Prager criterion, work hardening, flow laws.

Chapter 4: Plasticity of bars (3 weeks)
Modeling of traction–compression behavior, Explicit resolution of an elastoplasticity problem, Analytical solution, Numerical resolution of an elastoplastic problem, Calculation algorithms, Application to lattice structures.

Chapter 5: Plasticity of beams in bending (2 weeks)
Plasticity of beams, Reminders and notations, Elasto-plastic model, Pure bending, Simple bending, Simplified model – plastic hinge.

Evaluation method:
Continuous Control: 40%; Exam: 60%
Bibliographic references:

1. *D. François, A. Pineau and A. Zaoui. Mechanical behavior of materials. Hermès, Paris, 1991.*
2. *B. Halphen and J. Salençon. Elastoplasticity. Presses de l'École Nationale des Ponts et Chaussées, Paris, 1987.*
3. *J. Lemaitre and JL Chaboche. Mechanics of solid materials. Dunod, Paris, 1985.*
4. *J. Owen and E. Hinton. Finite Elements in Plasticity: Theory and Practice. Pineridge Press, New York, 1980.*

Semester 2
Teaching unit: FTU 1.2.1
Matter : Dimensioning of bridges 2
SHV: 45h00 (class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
Allow students to dimension the different elements of the infrastructure and equipment of any bridge as well as the seismic calculation of bridges following the Algerian seismic regulations for structures.

Recommended prior knowledge:
Dimensioning of bridges 1, Dynamics of structures 1, Concrete works project, SOM, Geotech.

Content of the material:
Chapter 1: Calculation of bridge slabs. **(3 weeks)**

Chapter 2: Bridge equipment (3 weeks)
Supports, Joint roadway, safety barrier.

Chapter 3: Calculation of supports **(3 weeks)**
Calculation of piers, Calculation of abutments.

Chapter 4: Seismic calculation of bridges **(6 weeks)**
Seismic load, Seismic calculation methods, RPOA 2008 Regulations, Elastic and inelastic response spectra, Seismic devices.

Evaluation method:
Continuous Control: 40%; Exam: 60%

Bibliographic references

1. *Design of bridges Berbard-Gely, Jean –Armand Calgarles*
2. *Shrinked elastomer bearings. SETRA Guide July 2007.*
3. *Bridge design and construction: general information, foundations, supports, current works. Jean-Armand Calgaro.*
4. *Algerian seismic regulations for engineering structures RPOA2008.*
5. *OPU collection, Algeria.*

Semester 2
Teaching unit:FTU 1.2.2
Matter: Prestressed concrete
SHV: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:
The objective of this subject is to give the student a basis allowing him to carry out the correct dimensioning of prestressed concrete structures with a certain knowledge of the technological aspect of prestressing processes.

Recommended prior knowledge:
Calculation of reinforced concrete cross sections, strength of materials

Material content:
Chapter 1: Additional concepts on prestressed concrete (1 week)
Introduction, Principle of prestressing, Advantages of prestressing.

Chapter 2: Materials used in prestressed concrete (1 week)
Cement, Concrete, Prestressing reinforcements, Passive reinforcements.

Chapter 3: Prestressing modes (2 weeks)
Prestressing by pre-tension, Prestressing by post-tension, Other techniques.

Chapter 4: Prestress losses (4 weeks)
Maximum value of the tension at the origin, Tension losses in post-tension, Instantaneous and delayed prestressing losses in post-tensioning, Tension losses in pre-tensioning, Instantaneous and deferred losses, Characteristic values of the tensions of the prestressing reinforcements.

Chapter 5: Normal resistance to bending (4 weeks)
General, Resistant sections, Actions and stresses, Verification classes, bending calculation at the SLS, Important concepts, Calculation of sections in classes I and II, Calculation of sections in class III, Bending calculation at the ULS, Balance of 'a section at the ULS, Characterization of an ultimate limit state, Principle of justifications, Equations of the problem, Other ultimate limit states.

Chapter 6: Resistance to tangent stresses (2 weeks)
Resistance to shear force, Effects of shear force, Reduction of shear force, Calculation of shear stress, Verification of shear force at SLS and ULS, Resistance to torsion, Notions important, Behavior of a RC or PC beam with respect to torsion, Verification of torsion at the SLS and the ULS.

Chapter 7: Justification for particular sections (1 week)
Introduction, Support zone, Zone of introduction of prestress in post-tension, Zone of introduction of prestress in pre-tension.

Evaluation method:
Continuous Control: 40%; Exam: 60%

Bibliographic references:

1. *Practical course in prestressed concrete by G.DREUX.*
2. *Construction in prestressed concrete by Y.GUYON.*
3. *Prestressed concretelimit statesby H.THONIER.*
4. *Prestressed concrete course by J.FAUCHET.*
5. *Prestressing by Albert CHAUSSIN and R. LA CROIX.*

Semester 2
Teaching unit: FTU 1.2.2
Matter: Metal constructions
SHV: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Allow the student to complete their knowledge and acquire other skills on the design of certain metal structures and calculation methods according to current regulations.

Recommended prior knowledge:
Knowledge acquired in license in SOM, MC, Technical Drawing.
Material content:

Chapter 1: Deviated flexion (2 weeks)
Reminders and general information, technological aspects, Dimensioning principles, calculation methods, deflection conditions, application examples (breakdowns and others).
Chapter 2: Calculation of parts subjected to compression (3 weeks)
The dangers of elastic instability phenomena, Simple compression (simple buckling), Compound buckling: Theoretical and regulatory aspects of simple and compound buckling (EC3 and CCM97), verification of compressed parts at the ULS.
Chapter 3: The Spill (3 weeks)
Presentation of the phenomenon of spillage, Torsional moment of inertia of open sections, Reminders on torsion with warping (non-uniform torsion), spillage in metal bridges.
Chapter 4: The Veil (2 weeks)
Theoretical, experimental and regulatory aspects (EC3 and CCM97), verification criteria and calculation methods.

Chapter 5: Post bases (2 weeks)
Articulated post bases, Recessed post bases: technological aspects, application examples.
Chapter 6: Mixed sections (3 weeks)
Advantages, different types of composite sections, Bending calculation, Shrinkage constraints, Design and calculation of connectors.
Evaluation mode
Continuous Control: 40%; Exam: 60%
Bibliographic references:

1) *J. Morel. "Calculation of Metal Structures according to Eurocode 3". Eyrolles, 2005.*
2) *"CCM97: Design rules for steel structures". CGS Algiers, 1999.*
3) *MY. Hirt, R. Bez. "Metal Construction", Volumes 10 and 11, Presses Polytechniques et Universitaires Romandes.*
4) *J. Brozzetti, MA Bez. "Metal construction (Numerical examples adapted to Eurocodes)". Presses Polytechniques et Universitaires Romandes.*
5) *OPU Collections, Algeria*
6) *Ministry of Housing, CGS,Design and calculation rules for steel structures CCM 97*

Semester 2
Teaching unit: MTU 1.2
Matter: Methods of Finished elements
SHV: 45h (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
The aim of this course is to introduce students to the calculation of structures using the finite element method by highlighting its principle, its advantages and its limits. The student must first be able to find the results of the SOM using the finite element method and solve some more complicated problems.

Recommended prior knowledge:
Mathematics, Resistance of materials, Elasticity.

Chapter 1: Introduction to the finite element method (1 week)
Definition, Procedure for using FEM in structural analysis.
Chapter2: Reminders on matrix calculation. (2 weeks)
Matrix formulation, Operation on matrices.
Chapter 3: Direct stiffness method (2 weeks)
System with a linear spring, System with several linear springs, Assembly, boundary conditions and concept of degrees of freedom.
Chapter 4: Bar finite elements (3 weeks)
Formulation of elementary characteristics, Rigidity matrix, Assembly and resolution, Transformation matrix, Calculation of internal forces.
Chapter 5: Bernoulli-Euler beam finite elements (3 weeks)
Formulation of elementary characteristics, Rigidity matrix, Assembly and resolution, Calculation of internal forces, Other linear elements, Torsional element, Beam-bar element, Taking into account shear in the beam, General beam element (Element at 12 degrees of freedom).
CHAPTER 6: Variational formulation of the elasticity problem (2 weeks)
General information on energy principles, Variational theorems, Principle of potential energy, Derivation of the rigidity matrix by the principle of minimum potential energy, Concepts of interpolation functions, Transformation of distributed loads into nodal loads.
Chapter 7: Approximation or interpolation functions (2 weeks)
One-dimensional Lagrange interpolation, Polynomial interpolation: Shape functions, Lagrange polynomial, Hermite polynomial, Pascal triangle, Conformity conditions.
Evaluation method:
Continuous Control: 40%; Exam: 60%
Bibliographic references:

1. *Finite element analysis of structures,J.F IMBERT, CÉPADUÈSE-EDITION, February 1995.*
2. *A presentation of the finite element method, Gouri Dhatt, Gilbert Touzot, Maloine SA publisher Paris.*
3. *Modeling of structures by finite elements, JL Batoz, Gouri Dhatt, Hermes Edition*
4. *Finite element method in structural mechanics, Thomas Gmur, Presses Polytechniques et Universitaires Romandes.*
5. *Finite element method. François Frey & Jaroslav Jirousek*
6. *Introduction to Finite Element Method, YIJUN LIU, University of Cincinnati, 1998.*
7. *The finite element method through exercises, ALLA CHATEAUNEUF, French Institute of Advanced Mechanics.2005.*

Semester 2
Teaching unit: MTU 1.2
Matter :Roads Project
SHV: 37h30 (class: 1h30, TD or PW: 1h00)
Credits: 3
Coefficient: 2

Teaching objectives:
This subject aims to complete the definition of the elements and characteristics necessary for the geometric design and dimensioning of roads taking into account the adaptation of the route to the needs of traffic and to attempt to create a mini project in road by exploiting the knowledge acquired since the license.

Recommended prior knowledge:
Soil mechanics, roads, drawing, topography, software applied to roads.

Content of the material:

Chapter 1: Development of intersections (3 Weeks)

Driver's problem, General principles of planning, Classification of intersections, Determination of geometric characteristics, Projection methods.

Chapter 2: Highways (4 Weeks)

General, Geometric characteristics, Interchanges, Establishment of highway projects.

Chapter 3: The different stages of a road project(1 week)

Chapter 4: Mini-project in roads (7 weeks)

The work consists of carrying out a mini project of a section of road, from the layout to the calculation of the cubature by exploiting the knowledge acquired. To develop this mini project, the following steps can be carried out:

1. Methodology
2. Construction of the axis in plan
3. Creation of the project
4. Axis Tabulation
5. Long profile and creation of the project
6. Definition of standard profiles
7. Project assignment, calculation, and drawing
8. Listing and general settings

Evaluation method:
Continuous Control : 40%; Exam: 60%

Bibliographic references:

1. R. Coquand. "Roads". Volumes 1 and 2, Eyrolles, 1985.
2. *Communication routes Roads Maritime works.N.Bos*
3. *Technical guide New roads (1994)*
4. *Pavement structure catalog RN (1998)*
5. *Mr. Faure. "Road courses". Volumes 1 and 2. Hazards.*
6. *L. Gagnon. "Road techniques". Modulo.*
7. *"B40: technical standards for road development in Algeria".*
8. *Collectionsof OPU, Algeria andSETRA-LCPC. France.*
9. *COLLECTIVE: Road and IT PARTS I,IIAndIII – Presses des P&CH, France.*

Semester 2
Teaching unit: MTU 1.2
Subject: Practical work Geographic information systems
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

The use of GIS will make it possible to extract additional information through their qualitative and quantitative analysis (e.g. calculation of distances, slopes, volumes, etc.). Synthetic documents are produced from data previously collected in the field. Practical lessons will be based on software from the GIS market such as: (MapInfo, ArcView, Arc GIS, etc.).

Recommended prior knowledge:

Computer science, basic knowledge acquired in license degree.

Content of the material:

PW1: The components of a GIS
Reminders and general information on geomatics, Software, Geographic data, Computer hardware, GIS architecture.

PW2: Structured geographic data
Spatial data organized in layers, Attribute data structured in a database.

PW3: Data in GIS
Attribute data, Spatial data

PW4: Methods of representing geographic data in a GIS
Vector mode, Raster mode, Rasterization/vectorization operation, Overview of the use of graphs in GIS.

PW5: Import, acquisition and display
Storage and archiving of geographic data in GIS, Topology and metrics, digital terrain model (DEM)

PW6: Applications
Spatial analysis

Evaluation method:

100% continuous control

Bibliographic references

1. *Software guides*
2. *S. Mantagné-Villette, "Cartography Remote Sensing Geographic Information Systems", Paris, 2000*
3. *J. Denègre, F. Salgé-Geographic information systems, 2004 -*

Semester: 2
Teaching unit: TTU 1.2
Subject: Respect for standards and rules of ethics and integrity.
SHV: 22h30 (Class: 1h30)
Credit: 1
Coefficient: 1

Teaching objectives:

Develop students' awareness of respect for ethical principles and the rules that govern life at university and in the world of work. Raise awareness about respecting and valuing intellectual property. Explain to them the risks of moral evils such as corruption and how to combat them, alert them to the ethical issues raised by new technologies and sustainable development.

Recommended prior knowledge:

Ethics and professional conduct (the foundations)

Content of the material:

A.The respect of the rulesethics and integrity,

1. **Reminder on the MESRS Charter of Ethics and Professional Conduct:** Integrity and honesty. Academic freedom. Mutual respect. Requirement for scientific truth, objectivity, and critical thinking. Equity. Rights and obligations of the student, the teacher, administrative and technical staff,

2. Integrity and responsible research

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

3. Ethics and professional conduct in the world of work:

Legal confidentiality in business. Loyalty to the company. Responsibility within the company, Conflicts of interest. Integrity (corruption in the workplace, its forms, its consequences, methods of combating and sanctions against corruption)

B- Intellectual property

I- Fundamentals of intellectual property

1- Industrial property. Literary and artistic property.
2- Rules for citing references (books, scientific articles, communications in a congress, theses, dissertations, etc.)

II- Copyright

1. Copyright in the digital environment

Introduction. Copyright databases, software copyright. Specific case of free software.

2. Copyright on the Internet and e-commerce

Domain name law. Intellectual property on the internet. E-commerce site law. Intellectual property and social networks.

3. Patent

Definition. Rights in a patent. Usefulness of a patent. The patentability. Patent application in Algeria and around the world.

III- Protection and valorization of intellectual property

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

C. Ethics, sustainable development and new technologies

Link between ethics and sustainable development, energy saving, bioethics and new technologies (artificial intelligence, scientific progress, Humanoids, Robots, drones,

Evaluation method:

Review: 100%

Bibliographic 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. Orders No. 933 of July 28, 2016 setting the rules relating to the prevention and fight against 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 GA, Bégin, L., Ethics and engineering, Montreal, McGraw Hill, 1991.
6. Siroux, D., Deontology: Dictionary of Ethics and Moral Philosophy, Paris, Quadrige, 2004, p. 474-477.
7. Medina Y., Ethics, what will change in the company, 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. of 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, n°94.
11. Jacquet-Francillon, François. Concept: professional ethics. The telemaque, May 2000, n° 17
12. Carr, D. Professionalism and Ethics in Teaching. New York, NY Routledge. 2000.
13. Galloux, JC, Industrial property law. Dalloz 2003.
14. Wagret F. and JM., Patent of invention, 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: copying and pasting among students, University of Grenoble 3 and University of Paris-Ouest Nanterre la Défense Nanterre, France
18. Didier DUGUEST IEMN, Cite your 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. Publication of the University of Montreal, Plagiarism prevention strategies, Integrity, fraud and plagiarism, 2010.
22. Pierrick Malissard, Intellectual property: origin and evolution, 2010.
23. The website of the World Intellectual Property Organizationwww.wipo.int
24. http://www.app.asso.fr/

V - Detailed programs by subject for the S3 semester

Semester: 3
Teaching unit: FTU 2.1.1
Subject: Advanced bridge designs
SHV: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Expand the field of knowledge of students in the design of complex bridges such as metal and composite bridges, prestressed concrete bridges built in successive cantilevers, cables bridges and bridges built by self-launching formwork. The student will have to discover other designs different from those of classic bridges.

Recommended prior knowledge:

SOM, metal framework, prestressed concrete, reinforced concrete, design of bridges 1 & 2.

Content of the material:

Chapter 1: Mixed deck bridges.

1) Mixed double girder bridge
   - Apron characteristics.
   - Analysis methods.
   - Justifications for the limit state sections.
   - Connection.

2) Mixed box bridge
   - Characteristics of the mixed box.
   - Global analysis.
   - Justifications for the limit state sections.

Chapter 2: Prestressed concrete bridges built with successive cantilevers.

- General principle and field of use;
- General design (static diagram, choice of cross section, pre-Dimensioning and cutting into segments);
- Design and justification of longitudinal cabling;
- Transversal and local behavior;
- Stability of flails;
- Construction technology.

Chapter 3: Cable bridges (suspension bridges, cable-stayed bridges, etc.)

- interest and technical-economic advantages of cable-stayed or suspended bridges;
- Components of cable-stayed bridges and suspension bridges;
- Design and study of the deck, pylons and stay cables;
- Verifications of construction limit states by phasing;
- Study of the effect of wind and seismic effect on the complex structure;
- Study of the types of deformations, in particular the torsion of the deck, the lateral bending due to the wind and vertical bending by lifting of the deck.

Chapter 4: Bridges constructed by self-launching formwork

- Geometric design and Dimensioning
- Seismic design of the bridge.
- Control of forces and constraints during construction stages
- Study of prestressing by phasing;
- Study of the rigidity of the self-breakable formwork;
- Construction technology and operation of self-launching formwork;

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references

12. *SETRA Guide "Eurocode 3 and 4 Application to mixed steel-concrete road bridges" July 2007*
13. *SETRA Guide "Double-girder mixed steel-concrete bridges" March 1990.*
14. *DTR "suspension bridges in France" SETRA & LCPC December 1989.*
15. *DTR "Prestressed bridges built by successive cantilevers" Technical Bulletin No. 7, 1972*
16. *SETRA Guide "Prestressed bridges built by successive cantilevers" June 2003.*
17. *SETRA Guide "ShroudsRecommendations of the interministerial prestressing commission »*November 2001.
18. *Guide to AFGC pushed bridges - Presses de l'école nationale des Ponts et Chaussées (ENPC) July 1999.*
19. *Bernard-Gely and Jean-Armand Calgaro, Design of bridges - Presses de l'école nationale des Ponts et Chaussées (ENPC), August 1994.*
20. *Grattesat, G, . Bridge design; courses at the National School of Bridges and Roads; Editions Eyrolles; Paris ; 1978; 291pp*
21. *Mathivat, J., Construction by corbelling of prestressed concrete bridges, Editions Eyrolles; Paris ; 1979; 340 pp.*

Semester: 3
Teaching unit: FTU 2.1.1
Subject: Underground works
SHV: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
Acquire the items the design and calculation of an underground structure.

Recommended prior knowledge:
Courses in SOM, Elasticity, and SM, Underground Infrastructures.

Content of the material:

Chapter 1: Design and execution of underground works (2 weeks)

Chapter 2. Reminders on the concepts of rock mechanics (3 weeks)
Methods for calculating rock structures
Modeling of the rock mass, stability of rock slopes, calculation of rock foundations,

Chapter 3: General information on tunnels**(2 weeks)**
(Terminology, longitudinal profile, cross profile, templates etc.), Operating equipment.

Chapter4: Construction of tunnels (4 weeks)
Digging techniques
Supporting and covering techniques,
Tunnel support methods (empirical methods, analytical methods, hyperstatic reaction method or others)

Chapter 5: Inspection, maintenance and repair of tunnels **(2 weeks)**

Chapter 6: Calculation of conducts (2 weeks)
General,
Classification of pipes according to use, shape, quality of materials, method of construction and method of installation.
Forces on pipes, internal forces, methods applied to the calculation of circular pipes, ovalization of circular pipes.

Evaluation method:
Continuous Control: 40%; Exam: 60%

Bibliography:

1. *M. Panet, Calculation of tunnels using the confinement convergence method, Presses de l'école nationale des ponts et chemins.*
2. *A. Bouvard-Lecoanet, G. Colombet, F. Esteulle, Underground structures: design, construction, maintenance, Presses de l'Ecole Nationale des Ponts et Chaussées*
3. *K. Szechy, Treatise on tunnel construction, Dunod.*
4. *Cherchali, Tunnels, Volumes 1, 2, 3, 4 and 5, OPU edition.*
5. *F. Martin, 2012, Rock Mechanics and Underground Works, Courses and corrected exercises*

Semester 3
Teaching unit: FTU 2.1.2
Matter: Railroads
SHV: 45h00 (class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
This course aims to define all the elements and characteristics necessary for the geometric design and Dimensioning of railway tracks with their interview.

Recommended prior knowledge:
Roads, soil mechanics, drawing, topography.

Content of the material:

Chapter 1: **General and Reminders** **(1 week)**
Rail transport, advantages and disadvantages, traffic categories.
Necessary step for the study of a railway track, execution project.

Chapter 2: Railway infrastructure (3 Weeks)
Introduction to the base of the railway track, different layers of base.
Dimensioning the seat structure

Chapter 3: Railway superstructure (2 Weeks)
Rail, jointing, sleepers (role of sleepers), fasteners

Chapter 4: Mechanics and track laying (1 week)
Forces supported by the track, laying of the track, Length of the rail, Joints between rails, Traveling.

Chapter 5: Plot elements **(5 weeks)**
Plan layout, Slope, Clothoid and Parabola parameters, Connection length, Longitudinal profile, Acceleration, Vertical radius, Main parameters for the choice of the longitudinal profile (calculation and Standards), Vertical connection elements (Tangent, Bisector).

Chapter 6: Stations **(1 week)**
Passenger stations, Passenger station equipment, Goods station, Station facilities.

Chapter 7: Maintenance of railway tracks (2 weeks)
Track maintenance, Maintenance of track devices, Renewal of track and track devices.

Evaluation method:
Mini Project (calculation and drawing): 40%; Exam: 60%

Bibliographic references:

1. *International Union of Railways UIC 703 R*
2. *Design of the current track layout V ≤ 220 km/h (version 1 of 09/12/06SNCF) UI C sheets*
3. *703R: layout characteristics of tracks traveled by high-speed passenger trains*
4. *741O: passenger platforms - rule for the establishment of platform edges by relationship to the path (4th edition, December 2005)*
5. *719R: earthworks and railway base layers.*

Semester: 3

Teaching unit: FTU 2.1.2
Subject: Aerodromes
SHV: 55 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Allow students to master the design and Dimensioning of airport platforms, as well as their management, maintenance and renovation.

Recommended prior knowledge:

Roads, SM

Material content:

Chapter 1: General information about ICAO (3 weeks)
Different parts of an airport infrastructure
Classification of aerodromes and aircraft
Aircraft technical data sheet.
Determination of air traffic

Chapter 2: Aeronautical Pavements (4 weeks)

Dimensioning of flexible pavements, flat rate method, optimized method.
Dimensioning of rigid pavements, flat rate method, optimized method.
Construction of aeronautical pavements, preparatory works, sanitation and drainage of the platform.

Chapter 3: Evaluation of residual lift (4 weeks)
Reverse method of Dimensioning (plate test)
Case of flexible pavements.
Case of rigid pavements.

Chapter 4: Management and monitoring of aeronautical pavements (4 weeks)
ACN/PCN method and aircraft eligibility criteria.
Repair and maintenance of aeronautical pavements.

Evaluation method:
Continuous assessment: 40%, exam 60%.

Bibliographic references:

1. *ICAO Annex 14*
2. *ITAC documents*
3. *STBA documents*
4. *Handout prepared by the teacher*

Semester: 3
Teaching unit: FTU 2.1.2
Matter: Pathology of works of art
SHV: 22h30 (Class: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Allows us to provide some basic information on the condition of a structure, the degradation mechanisms, and the repair methods in order to carry out corrective actions to improve the design and execution of future structures.

Recommended prior knowledge:

MDC, reinforced concrete, metal frame, bridge

Content of the material:

Chapter 1 : Concrete pathology (carbonation, alkali reaction, internal sulphate reaction, chemical and biological attacks, etc.).
Chapter 2 : Pathologies of metal bridges
Chapter 3: Pathologies of masonry bridges
Chapter 4: Pathologies foundations
Chapter 5: Auscultation methods
Chapter 6: Repair of structures (old and new methods)
Chapter 7: Monitoring and maintenance of engineering structures

Evaluation method:

100% review.

Bibliographic references:

1. *R. Lacroix and JA Calgaro, Maintenance and Repair of Bridges, Press of the National School of Bridges and Roads.*
2. *JP Olivier and A Vichot, Durability of concrete, Press of the National School of Bridges and Roads.*

Semester: 3
Teaching unit: MTU 2.1
Subject: Advanced geotechnics
SHV: 45 hours (Class: 1h30, TD or PW: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Become familiar with in situ testing for geotechnical reconnaissance.
Become aware of the difficulty in controlling the behavior of soils by introducing behavioral laws in the static and dynamic case to make it possible to deal with certain complex situations in terms of soil behavior.

Recommended prior knowledge:

SM, Elasticity

Content of the material:

Chapter 1: Reminders and general information (3 weeks)
Earth thrusts and thrusts, plasticity, and shear resistance of soils.

Chapter 2: Retaining structures and reinforcements against sliding (3 weeks)
Pre-Dimensioning of retaining structures, Static and dynamic studies of earth pressure (RPOA or SETRA), Study of stability (sliding, overturning, sliding circle), Reinforcement against sliding.

Chapter 3: Reinforced earth structures (2 weeks)
Design and implementation, economic evaluation.

Chapter 4: In situ tests (3 weeks)
Static and dynamic penetrometer test, Pressure-meter test, Plate test, Electrical and seismic gamma-graphic tests

Chapter 5: Soil behavior (2 weeks)
Static and dynamic case**,** Duncan's Law, Cam Clay's Law, Dynamic Case – Liquefaction Phenomenon

Chapter 6: Ballasted columns (2 weeks)
Definition, field of use, Method of realization and Economic interest, Design and Dimensioning (bearing capacity and settlement).

Practical work

Application of numerical methods (finite element methods, finite differences, etc.) to geotechnical problems (Foundations, Stability and landslides, Retaining structures, etc. Validation and interpretation of results.)

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references:

1. *Philipponnat and B. Hubert, Foundations and earthworks, Ed. Eyrolles, 1997*
2. *G. Frank, Calculation of superficial and deep foundations, Presses des ponts, 1999*
3. *J. Costet and G. Sanglerat, Practical course in soil mechanics (Volume 2) Ed. Dunod 1983*
4. *G. Sanglerat, G. Olivari and B. Cambou, Practical problems in soil mechanics and foundations (Volume 2) Ed. Dunod1983*

5. A. Dhouib,F. Blondeau, Ballasted columns: implementation techniques, areas of application, behavior, justification, control, areas of research and development, Presses des ponts, 2005.

Semester: 3
Teaching unit: MTU 2.1
Subject: Numerical modeling of bridges
SHV: 37h30 (PW: 2h30)
Credits: 3
Coefficient: 2

Teaching objectives:

This practical work will allow students to learn about the digital modeling of different types of bridges using finite element software. This software will allow them in the future to carry out different types of studies on bridges: static calculation, dynamic calculation, expertise, adaptation study, capacity study, etc. …

Recommended prior knowledge:

Dimensioning of bridges, dynamics of structures, reinforced concrete, prestressed concrete, metal framework, elasticity, finite elements.

Material content:

- **PW 1** The calculation software environment applied to bridges (SAP2000 BRIDGE, CSI BRIDGE, ROBOT, or others, etc.)
- **PW 2** Modeling of the main elements of a bridge.
- **PW3 Modeling** of the secondary elements of a bridge.
- **PW 4** Insertion of loads, stiffnesses and load combinations.
- **PW 5** Seismic calculation following the RPOA 2008 regulations.
- **PW 6** Exploitation of results.

Evaluation method:

Continuous control: 100%

Bibliographic references:

- *Handout prepared by the teacher*
- *RPOA2008 Regulation*
- *Software Guide*

Semester: 3
Teaching unit: MTU 2.1
Matter: Organization and visits of sites
SHV: (PW or site visit: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
Allow students:
- to acquire knowledge on innovative methods of organizing construction sites and their management.
- to understand the stages of a construction site and discover a construction site in real conditions.
- to meet professionals,

Recommended prior knowledge:
IT tools, knowledge of civil engineering and public works.

Material content:
The training team can choose according to the human and material resources available at the establishment level and according to the number of students, between teaching practical work on site organization and computer management tools such as Ms Project or others. (Part A) and/or carry out site visits (Part B) which constitute a recommended step to complete the training of students in the Public Works profession.

Part A: Organization of construction sites

Introduction to site organization (4 weeks)
Internal organization of construction sites, Installation of construction sites, Management of construction sites, Commissioning, Organization methods, Work planning instruments

Practical work
PW1: Introduction to the software used (Ms Project or other) **(2 weeks)**
PW2: Construction of the schedule with its phases **(2 weeks)**
PW2: Calculation of durations based on cadences, **(2 weeks)**
PW3: Determination of daily resources (people and machines) **(2 weeks)**
PW4: Calculation of the forecast budget (Labor + Machine). **(2 weeks)**
PW5: Material pricing evaluation. **(1 week)**

Part B: Site Visits
With at least one visit per month, the student will be able to discover different construction sites in real conditions, meet professionals, understand the stages of a construction site, etc. These visits can also lead to end-of-study projects.

✓ **Before the visit**
Preparation for the visit (requests, logistical means, etc.)
- Summary description of the site subject of the visit
- Explanation of construction site safety instructions
- Distribution of students into groups
- Reading plans if available

✓ **After the visit**

Production of reports of the site visit by the students formed into teams. The report of the visit must allow the teacher to check the ability of each team to organize the work.

Preparation of the report:

- Summary presentation of the project;
- Explain how the site works;
- Indicate the different specialties present on the site visited;
- Lessons and benefits of the visit

Evaluation method:

Part A: Continuous control: 100%.
Part B: Report of the visit:100%

Bibliographic references:

(Books and handouts, websites, etc.).

Semester: 3
Teaching unit: TTU 2.1
Matter: Documentary research and dissertation design
SHV: 22h30 (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
Give the student the necessary tools to search for useful information to better use it in their end-of-study project. Help them go through the different stages leading to the writing of a scientific document. Tell him the importance of communication and it learn to present the work carried out in a rigorous and educational manner.

Recommended prior knowledge:
Writing methodology, Presentation methodology.

Content of the subject:

Part I-: Documentary research:

Chapter I-1: Definition of the subject (02 Weeks)
- Subject title
- List of keywords relating to the subject
- Gather basic information (acquisition of specialized vocabulary, meaning of terms, linguistic definition)
- The information sought
- Take stock of your knowledge in the field

Chapter I-2: Select information sources (02 Weeks)
- Type of documents (Ldrunk, Theses, Memoirs, Periodical articles, Conference proceedings, Audiovisual documents, etc.)
- Type of resources (Libraries, Internet, etc.)
- Evaluate the quality and relevance of information sources

Chapter I-3: Locate documents (01 Week)
- Research techniques
- Search operators

Chapter I-4: To process information (02 Weeks)
- Work organization
- Starting questions
- Summary of documents retained
- Links between different parties
- Final plan of the documentary research

Chapter I-5: Presentation of the bibliography (01 Week)
- Systems for presenting a bibliography (The Harvard system, The Vancouver system, The mixed system, etc.)
- Presentation of documents.
- Citation of sources

Part II: Memory Design

Chapter II-1: Plan and stages of the dissertation (02 Weeks)

- Identify and delimit the subject (Summary)
- Problem and objectives of the dissertation
- Other useful sections (Acknowledgments, Table of abbreviations, etc.)
- The introduction (The writing of*the introduction last)*
- State of the specialized literature
- Formulation of hypotheses
- Methodology
- Results
- Discussion
- Recommendations
- conclusion and perspectives
- Table of contents
- The bibliography
- Annexes

Chapter II-2: Writing techniques and standards (02 Weeks)

- Formatting. Numbering of chapters, figures and tables.
- Cover Page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling. Improved general language skills in terms of comprehension and expression.
- Back up, secure, archive your data.

Chapter II-3: Workshop : Critical study of a manuscript **(01 Week)**

Chapter II-4: Oral presentations and defenses (01 Week)

- How to present a poster
- How to present an oral communication.
- Defense of a dissertation

Chapter II-5: How to avoid plagiarism? **(01 Week)**

(Formulas, sentences, illustrations, graphs, data, statistics,...)

- The quote
- The paraphrase
- Indicate the complete bibliographic reference

Evaluation method:

Review: 100%

Bibliographic references:

1. *M. Griselin et al., Guide to written communication, 2nd edition, Dunod, 1999.*
2. *JL Lebrun, Practical guide to scientific writing: how to write for the international scientific reader, Les Ulis, EDP Sciences, 2007.*
3. *HAS.Mallender Tanner, ABC of technical writing: instructions for use, user manuals, online help, Dunod, 2002.*
4. *M. Greuter, Write your dissertation or internship report well, L'Etudiant, 2007.*
5. *Mr. Boeglin, reading and writing in college. From the chaos of ideas to structured text. The Student, 2005.*
6. *M. Beaud, the art of the thesis, Editions Casbah, 1999.*
7. *M. Beaud, the art of the thesis, The discovery, 2003.*

M. Kalika, Master's thesis, Dunod, 2005.

VI- Detailed programs by subject of some Discovery Units (S1, S2, S3)

Semester:
Teaching unit: UEDXXX
Matter :Dams
SHV: 22h30 (class: 1h30, tutorial: 1h30)
Credits: 2
Coefficient: 2

Teaching objectives:

The objective of this teaching unit is to provide the student in training with knowledge of basic tools for the design of different types of dams.

Prior knowledge:

SM, Road geotechnics

Content of the material:

Chapter 1: General information on dams **(1 Weeks)**
Function, preliminary studies.
Chapter 2: Weight dams. **(3 weeks)**
Profile analysis and evolution of the profile, Stability of gravity dam walls.
Chapter 3: Buttress dams. (3 weeks)
Chapter 4: Arch dams. (4 weeks)
Chapter 5: Earth Dams (4 Weeks)
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Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references

1. *Anton J. Schleiss, Pougatsch H., Dams: from project to commissioning,*Treatise on Civil Engineering from the Federal Polytechnic School of Lausanne. Volume 17, 2011.
2. *Le Delliou P., Dams: design and maintenance, ENTPE, 2003*

Semester: X
Teaching unit: UETXXX
Subject: Market codes and legislation
SHV: 42 hours (class: 1h30, tutorial: 1h30)
Credits: 2
Coefficient: 2

Teaching objectives:

Future students will be able to know the different phases of public procurement procedures with a view to awarding a contract.

Recommended prior knowledge:

Mastery of the French language.

Content of the material:

Chapter 1 :General provisions
Chapter 2 :Structures involved in public procurement
Chapter 3:Public procurement
Chapter 4:Execution of public contracts
Chapter 5:Discipline and recourse
Chapter 6: Transitional and final provisions
Mention and price of contracts, payment terms, guarantees, amendments, subcontracting, termination, dispute resolution.

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references:

(Books and handouts, websites, etc.).

Semester:
Teaching unit: DTU XXX
Subject: Road safety 1
SHV: 45h00 (Class: 1h30, tutorial: 1h30)
Credits: 2
Coefficient: 2

Teaching objectives:

With the significant number of accidents, deaths and injuries recorded daily on the roads in Algeria, we are talking about the situation of road insecurity.
This subject essentially aims to introduce students to the importance of integrating road safety as an inseparable element in road projects (studies, design, construction, commissioning). On the other hand, acquiring knowledge about road safety makes it possible to strengthen the knowledge acquired on the design and dimensioning of roads and to broaden the vision of future executives towards new, safer designs which will better preserve the lives of users. of the road during the commissioning of these works.

Recommended prior knowledge:

Basics of statistics, Routes.

Content of the material:

Chapter 1: Concepts on security and risk (2 weeks)

Danger and dangerous phenomenon, Concepts of severity, frequency and exposure
Risk, criticality matrix, road risk, road safety

Chapter 2: Basic Accident Concepts **(2 weeks)**

Definition of a road accident,the consequences, the damage,the Man-Vehicle-Environment system

Chapter 4:: Road risk modeling **(3 weeks)**

History of road risk modeling, Concepts on simple and multiple regression, Smeed's law, SWOV model, DRAG model, other models.

Chapter 5: Road safety strategies (3 weeks)

Strategy definition, Vision zero, sustainable safety, strategy to improve road safety in developing countries

Chapter 6:: Overall situation of road safety in Algeria (5 Weeks)

Organization of road transport, bodies responsible for road safety, Evolution of accidents and victims in Algeria, Applications of some models for Algerian data.

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references

1- *Brenac, T. and Fleury, D. (1999). "The concept of a typical accident scenario and its applications", Research, Transport and Security, no. 63.*
2- *Brenac, T. (2004), "Road safety: a point ofcritical viewon preventive actions", in: Road safety: knowledge and action, Espaces et Sociétés, 118-3, Paris: Eres.*
3- *European commission, Best practices in road safety, Handbook for measures at the country level, 2007*
4- *Elvik R. Handbook of road safety measures. 2004.*

Semester:

Teaching unit: DTU XXX
Subject: Road safety 2
SHV: 45h00 (Class: 1h30, tutorial: 1h30)
Credits: 2
Coefficient: 2

Teaching objectives:

The road safety 2 subject aims to complete the knowledge acquired in the road safety 1 subject and introduce students to study work or road safety projects. Daily observations and the geographic spaces that students frequent can serve as examples of field studies. The knowledge acquired on statistics, computer science and programming, on geographic information systems and on mathematics as methods and tools can support students and teachers in carrying out the road safety project.

Recommended prior knowledge:

Road safety 1, statistics, Roads, IT, GIS.

Content of the material:

Chapter 1: road safety audits (3 weeks)

Definitions and objectives of an audit, different stages of an audit, road safety audit for new road projects, road safety audit for existing roads.

Chapter 2: road safety at the local level (5 Weeks)

Importance of local road safety studies as a complement to national studies,
Road safety in urban areas, notions of road sharing, safe roads in urban areas and road safety arrangements: 30 zones, meeting zones, cycle paths, etc.
road safety in rural areas, speed and severity of accidents, design of safe roads in rural areas, importance of roadway separation,

Chapter 3: road safety project (7 Weeks)

Definitions of a road safety project, Elements of the road safety project.

Project Content:

National road risk analysis

Analysis of road risk in urban areas: case study of a city, a district, a section of road or a road network of a city, choice of site, collection of statistical information, surveys and visits on the ground.

Analysis of road risk in rural areas: travel, in rural areas, case of a section or network of national roads, or section of motorway.

Means and tools:

- ✓ Statistical analysis of accidents (accidents, deaths, injuries, vehicle fleet, road network, etc.) using different software available (e.g., SPSS, Statistica, Excel, Origin, etc.)
- ✓ Analysis using econometric or mathematical models: Smeed, SWOV, DRAG, etc.
- ✓ Geographic analysis: use of geographic information system software (Map Info, ArcGIS, ArcView, etc.) to carry out spatial analysis, accident mapping, etc.
- ✓ Road safety databases
- ✓ Causes analysis
- ✓ others

Evaluation method:

Continuous Control: 40%; Exam: 60%

Bibliographic references

5- *Brenac, T. and Fleury, D. (1999). "The concept of a typical accident scenario and its applications", Research, Transport and Security, no. 63.*
6- *Brenac, T. (2004), "Road safety: a point ofcritical viewon preventive actions", in: Road safety: knowledge and action, Espaces et Sociétés, 118-3, Paris: Eres.*
7- *European commission, Best practices in road safety, Handbook for measures at the country level, 2007*
8- *Elvik R. Handbook of road safety measures. 2009.*
9- *African Development Bank, Transport & ICT Department, Road Safety Manuals for Africa, New Roads and Road Projects, Road Safety Audit, 2014*
10- *SETRA, 2005, Methodological guide: Safety control of road projects, Elements of quality approach for better consideration of safety.*

Semester:
Teaching unit: UEDXXX
Matter : Quantity and quote
SHV: 45h00 (class: 1h30, tutorial: 1h30)
Credits: 2
Coefficient: 2

Teaching objectives:
The objective of this teaching unit is to enable the student in training to acquire knowledge of the basic tools for establishing a preliminary estimate and a quote as well as knowledge of the different acts of quantity surveying.

Prior knowledge:
Thissubject requires the essential prerequisites such as: Construction drawing and CAD.
Content of the material:

Chapter 1: General concepts (1 Weeks)
Definition and purpose of the quantity survey and the preliminary take-off, the role of the quantity surveyor in construction, necessity and degree of precision of the evaluation of the works, the documents of the quantity survey andthe preliminary measurement.

Chapter 2 :The measurements of the quantity survey and the preliminary survey (2 weeks)
Summary estimates, quotes, attachments, work situations, accounts and memoranda

Chapter 3:Method of taking measurements and preliminary measurements of works (2 weeks)
Writing and form of presentationfrom the preliminary measurement,order ofthe preliminary measurementReminders of the usual formulas: measurement of areas and volumes (planes, polyhedra etc.), measurement of classic volumes – three levels method, Simpson and Poncelet formula

Chapter 4:Application of preliminary measurements of earthworks and excavations (3 weeks)
Preliminary measurements of excavations for foundations, calculation of earthwork quantities

Chapter 5:Masonry preliminary measurements (3 weeks)
Rubble masonry, brick masonry or agglomerates

Chapter 6:Pre-measurement of reinforced concrete (1 Weeks)
Concrete, formwork, reinforcement

Chapter 7:Price study (3 weeks)
Definition and purpose, sub-detail of prices, calculation methods, diagram and presentation of sub-detail of prices.

Evaluation method:
Review: 100%

Bibliographic references

1. *GussetJP, Preliminary survey - Earthworks, VRD and structural work, Principles - Basic works - Case studies - Applications,Eyrolles, 2015.*
2. *WidloecherY.,CusingD., Price study manual - Construction companies,Eyrolles, 2013.*