الجمهورية الجزائرية الديمقراطية الشعبية Democratic and Popular 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 Science and Technology sector

ACADEMIC MASTER HARMONIZE

National program

Updated 2022

Domain	Sector	Speciality
Sciences And Technologies	***Public Works***	***Roads and Engineering Structures***

الجمهورية الجزائرية الديمقراطية الشعبية Democratic and Popular 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 Science and Technology sector

مواءمة
ماستر أكاديمي

تحيين 2022

الميدان	الفرع	التخصص
علوم و تكنولوجيا	أشغالعمومية	طرقات ومنشآت فنية

II – Half-yearly teaching organization sheets of the specialty

Semester 1 Master: Roads and Engineering Structures

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**PW**			**Continuous Assessment**	**Exam**
Fundamental EU Code: UEF 1.1.1 Credits: 8 Coefficients: 4	Theory of Elasticity	4	2	1h30	1h30		45h00	55h00	40%	60%
	Dynamics of structures	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 1.1.2 Credits: 10 Coefficients: 5	Bridge design	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Road design	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological EU Code: UEM 1.1 Credits: 9 Coefficients: 5	Reinforced Concrete Works Project	5	3	1h30	1h30	1 hour	60h00	65h00	40%	60%
	Practical Programming	2	1			1h30	10:30 p.m.	27:30	100%	
	PW Software Applied to Roads	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 1.1 Credits: 2 Coefficients: 2	*Soils Méchanic*	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
	tutorial of Soil mechanic	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 1.1 Credits: 1 Coefficients: 1	Technical English and Terminology	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 1		**30**	**17**	**1:30 p.m.**	**7:30 a.m.**	**4:00 a.m.**	**375 hours**	**375 hours**		

Semester 2 Master: Roads and Engineering Structures

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**PW**			**Continuous Assessment**	**Exam**
Fundamental EU Code: UEF 1.2.1 Credits: 8 Coefficients: 4	Theory of Plasticity	4	2	1h30	1h30		45h00	55h00	40%	60%
	Bridges design 2	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 1.2.2 Credits: 10 Coefficients: 5	Prestressed Concrete	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Metal constructions	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological EU Code: UEM 1.2 Credits: 9 Coefficients: 5	Finite element methods	4	2	1h30	1h30		45h00	55h00	40%	60%
	Road project	3	2	1h30		1 hour	37h30	37h30	40%	60%
	Geographic Information Systems (GIS) practical work	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 1.2 Credits: 2 Coefficients: 2	**Earthquake Engineering**	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
	Maritime structures	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 1.2 Credits: 1 Coefficients: 1	Compliance with standards and rules of ethics and integrity	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 2		**30**	**17**	3:00 p.m.	7:30 a.m.	2h30	**375 hours**	**375 hours**		

Semester 3 Master: Roads and Engineering Structures

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**PW**			**Continuous Assessment**	**Exam**
Fundamental EU Code: UEF 2.1.1 Credits: 8 Coefficients: 4	Advanced Bridge Designs	4	2	1h30	1h30		45h00	55h00	40%	60%
	Underground structure	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 2.1.2 Credits: 10 Coefficients: 5	Railways	4	2	1h30	1h30		45h00	55h00	40%	60%
	Airfields	4	2	1h30	1h30		45h00	55h00	40%	60%
	Pathology and rehabilitation of OA	2	1	1h30			10:30 p.m.	27:30		100%
Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	Advanced geotechnics	4	2	1h30		1h30	45h00	55h00	40%	60%
	Digital Modeling of Bridges	3	2			2h30	37h30	37h30	100%	
	Organization and site visits	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 2.1 Credits: 2 Coefficients: 2	**Road geotechnics**	1	1	1h30	1h30		10:30 p.m.	2:30 a.m.		100%
							10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 2.1 Credits: 1 Coefficients: 1	Documentary research and dissertation design	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 3		**30**	**17**	1:30	6:00	5:30	**375 hours**	**375 hours**		

				p.m.	a.m.	a.m.				

III - Detailed program by subject for semester S1

Semester 1
Teaching unit: UEF 1.1.1
Subject: Theory of Elasticity
SHV: 45 hours (lesson: 1 hour 30 minutes, tutorial: 1 hour 30 minutes)
Credits: 4
Coefficient: 2

Teaching objectives:

To 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 covered.

Recommended prior knowledge:

Basic mathematical tools and RDM.

Content of the subject:

Chapter 1: Generalities on continuous media mechanics (CMM) . (2 Weeks)

Elasticity theory with respect to MMC, RDM.
Basic assumptions of elasticity theory.

Chapter 2 : Tensor Notations (2 Weeks)

Vectors and tensors (Notations, Change of reference frame
Permutations and determinants (Permutation symbols,
Determinant of a matrix, Characteristic polynomial
Vector calculus 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: Theory of the state of deformation. (4 Weeks)

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

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

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

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

Generalities. Type I, II and III problems.

Principles of superposition, uniqueness of the St Venant solution.
Principles of conservation of energy.
General equations of elasticity (Solutions as a function of displacements:
Lamé equations, Solutions depending on constraints: Beltrami-Mitchell equations.

Assessment method:

Continuous Assessment: 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. *Course in elasticity, 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: UEF 1.1.1
Subject: Structural dynamics
VHS: 45h00 (lesson: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

To present a treatment of the modern theory of the calculation of structures subjected to dynamic stresses and to make the student aware of the problems of vibration 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 subject:

Chapter 1: Dynamic behavior of structures **(5 Weeks)**
Mathematical models and degrees of freedom
Mathematical models
Dynamic response

Chapter 2: One-degree-of-freedom systems **(5 weeks)**
Formulation of the equation of motion
(Modeling, Principle of virtual work, Hamilton's principle)
Vibration of one-degree-of-freedom systems **:**
(Undamped free vibrations, Damped free vibrations,
Harmonic excitation, periodic, special and general excitations)

Chapter 3: Multi-degree of freedom systems **(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,
Approximate methods for evaluating natural frequencies and modes)
Systems with distributed characteristics (Bending of beams, Free vibration
Forced vibration of multi-degree-of-freedom systems (Modal superposition method,
Step-by-step integration method)

Assessment method:

Continuous Assessment: 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. *Dynamics of Structures – Fundamental Principles, RW Clough & J. Penzien Pluralis Editions.*
4. *calculation of structures in seismic zones, A. Capra & V. Davidovici, Eyrolles editions.*

Semester 1
Teaching unit: UEF 1.1.2
Subject: Bridge design
Total Hours: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Course Objectives:
The student will be able to design bridge decks of standard bridges and various bridge equipment.

Recommended Prerequisites:
Knowledge acquired during the bachelor's degree in Bridge Engineering 1, Strength of Materials, Road Engineering 1 & 2, Structural Analysis, and the Algerian Seismic Code (RPOA).

Course Content:

Chapter 1: Generalities and Review **(2 weeks)**
Components of bridges, loads and stresses on bridges, types of bridges.

Chapter 2: Theory of Influence Lines **(3 weeks)**
Influence lines for statically determinate beams, trusses, and indeterminate beams.

Chapter 3: Design of Bridge Slabs **(4 weeks)**

Chapter 4: Design of Beams with Assumed Infinitely Rigid Cross Beams **(2 weeks)**
Courbon's method.

Chapter 5: Design of Beams with Finite Stiffness Cross Beams **(2 weeks)**
Guyon-Massonnet method.

Chapter 6: Bridge Equipment **(2 weeks)**
Design of bearings and seismic connections, design of expansion joints, safety barriers.

Chapter 7: Design of Supports **(2 weeks)**
Design of piers and abutments.

Evaluation Method:
Continuous Assessment: 40% ; Final Exam: 60%

Bibliographic References:
1. *Projet et construction des ponts, Analyse structurale des tabliers de ponts, tome 2 par CALGARO J.M.*
2. *Poutres à parois minces par CALGARO par J.M.*
3. *Théory of box girders par V. KISTEK*

Tabliers des ponts par B. GREZES et par P. LECROQ

Semester 1
Teaching unit: UEF 1.1.2
Subject: Road design
VHS: 45 hours (lesson: 1 hour 30 minutes, tutorial: 1 hour 30 minutes)
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 layout to traffic needs.

Recommended prior knowledge:

Soil mechanics, roads, drawing, topography.

Content of the subject:

Chapter 1 : General Information and Reminders **(2 Weeks)**

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

Chapter 2: Design and 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 roads
- Roles of the different layers of a flexible pavement

Chapter 4: Models of road mechanics**(2 Weeks)**

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

Chapter 5: Dimensioning of road pavements **(3 Weeks)**

- Sizing methods (Theoretical, empirical and semi-empirical)
- Fundamental parameters for sizing studies
- Modified CBR Method based on TPL, CEBTP Method , AASHTO Method and Shell Method
- Algerian method for dimensioning new roads (CTTP catalog)

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

Chapter 6 : Crossroads planning **(2 weeks)**

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

Chapter 7 : Highways**(2 Weeks)**

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

Assessment method:

Continuous Assessment: 40%; Exam: 60%

Bibliographic references:

1. *Routes, R.Coquand Eyrolles1985,*
2. *Roads and Airfields. PM-Clichy Beugnet 1983*
3. *Communication routes, roads, maritime works. N.Bos*
4. *B 40 technical standards for road development*
5. *Technical guide for new roads (1994)*
6. *RN road structure catalog (1998)*
7. *Low-traffic roadway manual*
8. *Technical guide for concrete pavements (1997)*
9. *1. LCPC-SETRA. "Road earthworks guide: Construction of embankments and subgrades". Technical guide, France, 2000.*
10. *LCPC-SETRA. "Soil treatment 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. "Laboratory and on-site soil mechanics tests: Aide-mémoire". LPC report, France, 1980.
12. *F. Schlosser. "Elements of soil mechanics". Presses des Ponts, France, 1988. OPU Collections, Algeria.*

Semester 1
Teaching unit: UEM 1.1
Subject 1:Reinforced Concrete Works Project
VHS: 60h00 (Class: 1h30, TD: 1h30, PW: 1h00)
Credits: 5
Coefficient: 3

Teaching objectives:

The purpose of this course is to enable the student to carry out a study of reinforced concrete structures in the field of civil engineering (calculation, dimensioning and verification).

Recommended prior knowledge:

Knowledge acquired during the Bachelor's degree course.

Content of the subject:

Chapter 1: Structural frames in BA **(2 Weeks)**
Design, sizing, calculation and justifications
structural elements in BA (posts, beams and walls)

Chapter 2: Calculation of shallow foundations in BA **(3 Weeks)**
Reminder on the connecting rod method;
Design, sizing, calculation and justifications
(centered loading and eccentric loading) for:
isolated foundations, continuous foundations and general foundation raft.

Chapter 3: Calculation of deep foundations in BA **(3 Weeks)**
Design, sizing, calculation and justifications
pile foundations, 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 overload

Chapter 5 : Calculating Floors **(3 Weeks)**
Solid slab floor, ribbed floor, orthogonal beam floors, mushroom floors, prefabricated floor.

Practical work

Teaching objectives:

The aim of these practical exercises is to introduce students to the various software used in the modeling of simple structures in civil engineering using software such as: Robot Structural Analysis Professional, SAP, ETABS or others. This step will facilitate the modeling of civil engineering structures later on.

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

Assessment method:

Continuous Assessment: 40%; Exam: 60%

Bibliographic references

1. *Design 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. *Treatise on 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. *Pflug L., Lestuzzi P., Bar and beam structures , Analysis of continuous structures and environments – civil engineering treatise - Volume 4, 2014.*
6. *Software guides*

13.

Semester 1
Teaching unit: UEM 1.1
Subject: Practical Programming
VHS: 10:30 H. (PW: 1:30 h)
Credits: 2
Coefficient: 1

Teaching objectives:

The aim of these practical exercises is to introduce students to acquiring a basis in direct or programming calculations, in order to resolve the various problems that arise in structural mechanics.

Recommended prior knowledge:

Strength 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 .

Content of the material:

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, operations on polynomials,
PW3: 2D graphics, from points, or from a function, 3D graphics: mesh, axes, visualization,
PW4: Character strings, file manipulation,
PW5: Applications in RDM: Calculation of forces and deformations in a simple and continuous beam under distributed and concentrated loads,
PW6: Reinforced concrete applications: Calculation of compression, traction and simple bending forces.

Assessment method :
Continuous assessment: 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 the student with Matlab, JT Lapreste, Ellipse, 2008.*
8. *Matlab for engineers, A. Biran, Pearson Edition, 2004.*

Semester 1
Teaching unit: UEM 1.1
Subject Practical work - Software Applied to Roads
VHS: 10:30 H. (PW: 1:30 h.)
Credits: 2
Coefficient: 1

Course Objectives:

This practical work aims to define all elements and characteristics necessary for geometric design of roads to develop a rational and economical alignment, dimension, and successfully execute road construction.

Recommended Prerequisites:

Roads, computer science.

Course Content:

- **Practical Work 1:** Road calculation software environment (Covadis or Piste);
- **Practical Work 2:** Interpolation of topographic points;
- **Practical Work 3:** Horizontal Alignment;
- **Practical Work 4:** Vertical Profile;
- **Practical Work 5:** Cross-Section**.**

Assessment method :

Continuous assessment: 100%

Bibliographic references :

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

Semester: 1
Teaching unit: UET 1.1
Subject 1: Technical English and Terminology
SHV: 22h30 (1h30 lecture)
Credits: 1
Coefficient: 1

Teaching objectives:

Introduce students to technical vocabulary. Reinforce their knowledge of the language. Help students understand and synthesize a technical document. Enable students to understand an English conversation in a scientific context.

Recommended prior knowledge: Basic English vocabulary and grammar

Course content:

Chapter 1 (4 weeks)
Reading comprehension: Reading and analysis of texts relating to the specialty.

Chapter 2 (4 weeks)
Oral comprehension: Using authentic popular science videos, take notes, summarize and present the document.

Chapter 3 (4 weeks)
Oral expression: Presentation of a scientific or technical subject, preparation and exchange of oral messages (ideas and data), telephone communication, body language.

Chapter 4 (3 weeks)
Written expression: extracting ideas from a scientific document, writing a scientific message, exchanging information in writing, drafting CVs, letters of application for internships or jobs.

Recommendation: It is strongly recommended that at the end of each session (at the most), the person in charge of the subject matter presents and explains a dozen or so technical words from the subject matter in the three languages (if possible) English, French, and Arabic.

Evaluation method: Examination: 100%.

Bibliographical References:

1. J. *Comfort, Guide pratique pour rédiger en anglais: usages et règles, conseils pratiques, Editions d'Organisation 2007*
2. *A. Chamberlain, R. Steele, Guide pratique de la communication: anglais, Didier 1992*
3. *R. Ernst, Dictionnaire des techniques et sciences appliquées: français-anglais, Dunod 2002.*
4. *J. Comfort, S. Hick, and A. Savage, Basic Technical English, Oxford University Press, 1980*
5. *E. H. Glendinning and N. Glendinning, Oxford English for Electrical and Mechanical Engineering, Oxford University Press 1995*

IV - Detailed programs by subject for semester S2

Semester 2
Teaching unit: UEF 1.2.1
Subject :Plasticity theory
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
The purpose of this course is to introduce the student to the theoretical notions of the theory of structural plasticity.

Recommended prior knowledge:
Algebra, Continuous Media Mechanics, Rational Mechanics, Fluid Mechanics, Strength of Materials

Chapter 1: Mechanical Testing (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, Hardenable elastoplastic solid, Viscoplasticity.

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

Chapter 4:Plasticity of bars(3 Weeks)
Modeling of traction-compression behavior, Explicit resolution of an elasto-plasticity problem, Analytical solution, Numerical resolution of an elasto-plastic 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.

Assessment method:
Continuous Assessment: 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. Press of the National School of Bridges and Roads, Paris, 1987.*
3. *J. Lemaitre and J.L. 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: UEF 1.2.1
Subject: Bridge design 2
VHS: 45 hours (lesson: 1 hour 30 minutes, tutorial: 1 hour 30 minutes)
Credits: 4
Coefficient: 2

Course Objectives:
To enable students to design the various elements of a bridge's infrastructure and equipment, as well as perform seismic design calculations according to the Algerian seismic code for civil engineering structures (RPOA 2008).

Recommended Prerequisites:
Bridge Design 1, Structural Dynamics 1, Concrete Structures Project, Strength of Materials, Geotechnics.

Course Content:
Chapter 1: Design of bridge slabs **(3 weeks)**

Chapter 2: Bridge equipment **(3 weeks)**
Bearings, Expansion joints, Safety barriers.

Chapter 3: Design of supports **(3 weeks)**
Design of piers and abutments.

Chapter 4: Seismic design of bridges **(6 weeks)**
Seismic loads, seismic calculation methods, RPOA 2008 code, elastic and inelastic response spectra, seismic protection devices.

Evaluation Method:
Continuous Assessment: 40% ; Final Exam: 60%

Bibliographic References:

1. *Conception des ponts Berbard-Gely, Jean –Armand Calgarles*
2. *Appareils d'appui en élastomère fretté. Guide SETRA juillet 2007.*
3. *Projet et construction des ponts: généralités, fondations, appuis, ouvrages courant. Jean-Armand Calgaro.*
4. *Règlement parasismique algérien des Ouvrages d'art RPOA2008.*
5. *Collection OPU, Algérie.*

Semester 2
Teaching unit: UEF 1.2.2
Suject: Prestressed Concrete
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

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

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

Content of the material:

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 reinforcement, Passive reinforcement.

Chapter 3:Prestressing modes (2 weeks)
Pre-tensioning, Post-tensioning, Other techniques.

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

Chapter 5: Normal Bending Strength (4 weeks)
Generalities, Resistant sections, Actions and stresses, Verification classes, Bending calculation at ELS, Important concepts, Calculation of sections in classes I and II, Calculation of sections in class III, Bending calculation at ULS, Equilibrium of a section at ULS, Characterization of an ultimate limit state, Principle of justifications, Putting the problem into equations, Other ultimate limit states.

Chapter 6: Resistance to tangential 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, Important concepts, Behavior of a BA or BP beam with respect to torsion, Verification of torsion at SLS and ULS.

Chapter 7: Justification of particular sections (1 week)
Introduction, Support zone, Post-tensioning prestressing introduction zone, Pre-tensioning prestressing introduction zone.

Assessment method:
Continuous Assessment: 40%; Exam: 60%

Bibliographic references:

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

Semester 2
Teaching unit: UEF 1.2.2
Subject : Metal constructions
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

To enable the student to complete his 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 RDM, CM, Technical Drawing.
Content of the material:

Chapter 1:Deviated flexion (2 weeks)
Reminders and general information **,** technological aspects, sizing principles, calculation methods, deflection conditions, application examples (failures 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 ULS.
Chapter 3: The Spill (3 weeks)
Presentation of the phenomenon of tilting, Torsional moment of inertia of open profiles, Reminders on torsion with warping (non-uniform torsion), tilting in metal bridges.
Chapter 4: The Veiling (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 mixed sections, bending calculation, shrinkage stresses, design and calculation of connectors.
Assessment method
Continuous Assessment: 40%; Exam: 60%
Bibliographic references:

1) *J. Morel. "Calculation of Metallic Structures according to Eurocode 3". Eyrolles, 2005.*
2) *"CCM97: Design rules for steel structures". CGS Algiers, 1999.*
3) *M.-A. Hirt, R. Bez. "Metal Construction", Volumes 10 and 11, Polytechnic and University Presses of Romandie.*
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, Rules for the design and calculation of steel structures CCM 97*

Semester 2
Teaching unit: UEM 1.2
Subject: Finites elements method
VHS: 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, advantages and limitations. The student should be able to first recover the results of the RDM using the finite element method and solve some more complicated problems.

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

Chapter 1: Introduction to the finite element method (1 week)
Definition, Procedure for using FEM in structural analysis.

Chapter 2: Reminders on matrix calculation. (2 weeks)
Matrix formulation, Operation on matrices.

Chapter 3: Direct Rigidity Method (2 weeks)
Single linear spring system, Multiple linear spring system, Assembly, boundary conditions and concept of degrees of freedom.

Chapter 4: Finite element bars (3 weeks)
Formulation of elementary characteristics, Stiffness matrix, Assembly and resolution, Transformation matrix, Calculation of internal forces.

Chapter 5: Finite elements of Bernoulli-Euler beams (3 weeks)
Formulation of elementary characteristics, Stiffness matrix, Assembly and resolution, Calculation of internal forces, Other linear elements, Torsion element, Beam-bar element, Consideration of shear in the beam, General beam element (Element with 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 stiffness matrix by the principle of minimum potential energy, Notions of interpolation functions, Transformation of distributed loads into nodal loads.

Chapter 7: Approximation or Interpolation Functions (2 weeks)
One-dimensional Lagrange-type interpolation, Polynomial interpolation: Shape functions, Lagrange polynomial, Hermite polynomial, Pascal's triangle, Conformity conditions.

Assessment method:
Continuous Assessment: 40%; Exam: 60%

Bibliographic references:

1. *Analysis of structures by finite elements , J.F. IMBERT, CÉPADUÈSE-ÉDITION, 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 by exercises, ALLA CHATEAUNEUF, French Institute of Advanced Mechanics . 2005.*

Semester 2
Teaching unit: UEM 1.2
Subject: Roads Project
VHS: 37h30 (lesson: 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 traffic needs and to attempt to make a mini road project using the knowledge acquired since the degree.

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

Content of the subject:

Chapter 1: Intersection design **(3 Weeks)**
Driver-related issues, General principles of intersection design, Classification of intersections, Determination of geometric characteristics, Projection methods.
Chapter 2: Highways **(4 Weeks)**
General concepts, Geometric characteristics, Interchanges, Highway project development.
Chapter 3: The different stages of a road project **(1 Week)**
Chapter 4: Road mini project **(7 Weeks)**
The work consists of completing a mini project for a road segment, from alignment to volume calculation, utilizing acquired knowledge. To develop this mini project, the following steps may be undertaken:
1. Methodology;
2. Construction of horizontal alignment;
3. Project creation;
4. Axis tabulation;
5. Vertical profile and project creation;
6. Definition of typical profiles;
7. Assignment, calculation, and project design;
8. General listing and parameterization.

Assessment method:
Continuous Assessment: 40%; Exam: 60%

Bibliographic references:
1. R. Coquand. "Routes". Volumes 1 and 2, Eyrolles, 1985.
2. *Communication routes Roads Maritime works. N.Bos*
3. *Technical guide for new roads (1994)*
4. *RN road structure catalog (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. *Collections of the OPU, Algeria and SETRA-LCPC, France.*
9. *COLLECTIVE: Road and IT PARTS I , II and III– Presses des P&CH, France.*

Semester 2
Teaching unit: UEM 1.2
Subject: Practical work Geographic information systems
VHS: 10:30 p.m. (PW: 1:30 p.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

The use of GIS will allow the extraction of additional information through their qualitative and quantitative analyses (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 a bachelor's degree.

Content of the subject:

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 into layers, Attribute data structured in a database.
PW3 : Data in GIS
Attribute data, Spatial data
PW4 : Modes 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 a GIS, Topology and metrics, digital terrain model (DTM)
PW6 :Applications
Spatial analysis

Assessment method:

100% continuous assessment

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 8.9
Subject :Maritime Structures
SHV: 22h30 (1h30 lecture)
Credits: 1
Coefficient: 1

Teaching aim: The aim of this course is to familiarize students with the rules governing the design and construction of civil marine structures in accordance with current standards.

Prerequisites: Strength of materials 1, Soil mechanics 1, Building materials, Reinforced concrete.

Course content:

Chapter 1:General information on maritime ports (2 weeks)

Interests of maritime transport, History, Types of ports, Characteristics.

Chapter 2:Port and river structures (3 weeks)

Docks, Dry docks, Dykes, Locks.

Chapter 3:Shoreline protection (5 weeks)

Coastal regimes, Ways of protecting maritime shorelines, Various defensive structures, Stability studies and construction methods.

Chapter 4:Signalling structures and equipment (3 weeks)

Optical signalling, audible signalling, radio signalling.

Chapter 5: **Harbour operation and maintenance** (2 weeks)

Maritime service, Lighthouse and beacon service, Harbour dredging.

Evaluation method: Examination: 100%.

References:

1. Collections OPU, Algérie.
2. Other documents.

Semester: 2
Teaching unit: UET 1.2
Subject: Compliance with standards and rules of ethics and integrity.
VHS: 10:30 p.m. (Class: 1.5 hours)
Credit: 1
Coefficient: 1

Teaching objectives:

To raise student awareness of the ethical principles and rules that govern life at university and in the workplace. To raise awareness of the need to respect and value intellectual property. To explain the risks of moral evils such as corruption and how to combat them, and to 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 subject:

A.Respect for the rules of ethics and integrity,

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

2. Integrity and responsible research

- Respect for the principles of ethics in teaching and research
- Responsibilities in Teamwork: Professional equality of treatment. Conduct against discrimination. Pursuit of the public interest. Inappropriate conduct in teamwork .
- 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 world of work:

Legal confidentiality in business. Corporate loyalty. Corporate responsibility. Conflicts of interest. Integrity (corruption in the workplace, its forms, 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

Database copyright , software copyright . Specific case of free 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 application in Algeria and around the world .

III- Protection and promotion of intellectual property

How to protect intellectual property. Rights violations and legal tools. Valuing intellectual property. Protecting 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,

Assessment method:

Exam: 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. Order No. 933 of July 28, 2016 establishing 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, pp. 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, no. 94.
11. Jacquet-Francillon, François. Concept: professional ethics. Le télémaque, May 2000, no. 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., 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 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, Strategies for preventing plagiarism, 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/

V - Detailed programs by subject for semester S3

Semester: 3
Teaching unit: UEF 2.1.1
Subject: Advanced Bridge Designs
VHS: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives: To broaden students' knowledge of the design of complex bridges such as steel and composite bridges, prestressed concrete bridges built using successive corbelling, cable-stayed bridges and bridges built using self-launching formwork. The student will discover other designs that differ from those of conventional bridges.

Recommended prerequisites:RDM, steel structures, prestressed concrete, reinforced concrete, bridge dimensioning1 & 2.

Contents:

Chapter 1: Mixed-deck bridges.

1) Mixed double-girder bridge
- Deck characteristics;
- Analysis methods;
- Limit state section justifications;
- Connection.

2) Mixed box bridge
- Characteristics of the mixed box;
- Overall analysis;
- Limit state section justifications.

Chapter 2: Prestressed concrete bridges built with successive corbelling
- General principle and field of use;
- General design (static diagram, the choice of cross-section, pre-dimensioning and segmenting);
- Longitudinal cabling design and justification;
- Transverse and local behavior;
- Beam stability;
- Construction technology.

Chapter 3: Cable-stayed bridges (Suspension bridges, Cable-stayed bridges,...)
- interest and technico-economic advantages of cable-stayed or suspension bridges;
- Components of cable-stayed and suspension bridges;
- Design and study of the deck, pylons and cable-stayed cables;
- Construction limit state checks by phasing;
- Study of the effect of wind and seismic effect on the complex structure;
- Study of deformation types, including deck torsion, lateral bending due to wind and vertical bending by deck uplift.

Chapter 4: Bridges built using self-launching formwork
- Geometric design and dimensioning
- Seismic design of the bridge.
- Controlling stresses and strains during construction stages
- Study of prestressing by phasing;
- Study of the rigidity of self-laminating formwork;

- Construction technology and operation of self-laminating formwork.

Evaluation method:
Continuous assessment: 40%; Examination: 60%

References

12. *Guide SETRA « Eurocode 3 et 4 Application aux ponts-routes mixtes acier-béton » Juillet 2007*
13. *Guide SETRA « Ponts mixtes acier-béton bipoutres » Mars 1990.*
14. *DTR « les ponts suspendus en France » SETRA & LCPC Décembre 1989.*
15. *DTR « Ponts précontraints construits par encorbellements successifs » Bulletin technique n°7, 1972*
16. *Guide SETRA « Ponts précontraints construits par encorbellements successifs »Juin 2003.*
17. *Guide SETRA « Haubans Recommandations de la commission interministérielle de la précontrainte »* Novembre 2001.
18. *Guide des ponts poussés D'A.F.G.C. - Presses de l'école nationale des Ponts et Chaussées (ENPC) Juillet 1999.*
19. *Bernard-Gely et Jean-Armand Calgaro, Conception des ponts - Presses de l'école nationale des Ponts et Chaussées (ENPC), Août 1994.*
20. *Grattesat, G, . Conception des ponts ; cours de l'Ecole Nationale des Ponts et Chaussées ; Editions Eyrolles ; Paris ; 1978 ; 291 pp*
21. *Mathivat, J., Construction par encorbellement des ponts en béton précontraint, Editions Eyrolles ; Paris ; 1979 ; 340 pp.*

Semester: 3
Teaching unit: UEF 2.1.1
Subject: Underground Structures
VHS: 45 hours (Class: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

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

Recommended prerequisites: RDM, Elasticity and MDS courses, Underground Infrastructures.

Course content:

Chapter 1: Designing and building underground structures (2 weeks)

Chapter 2: Rock mechanics (3 weeks)
Calculation methods for rock structures, Rock modelling, stability of rock slopes, calculation of rock foundations.

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

Chapter 4: Tunnel construction (4 weeks)
Excavation techniques, Support and lining techniques, Tunnel support methods (empirical methods, analytical methods, hyperstatic reaction method or others)

Chapter 5: Tunnel inspection, maintenance and repair (2 weeks)
Chapter 6: Pipe design (2 weeks)
General, Classification of pipes according to use, shape, material quality, construction and laying method, Forces on pipes, internal forces, methods applied to the calculation of circular pipes, ovalization of circular pipes

Evaluation method: Continuous assessment: 40%; Examination: 60%

Bibliography:

1. *M. Panet, Le calcul des tunnels par la méthode de convergence confinement, Presses de l'école nationale des ponts et chaussées.*
2. *A. Bouvard-Lecoanet, G. Colombet, F. Esteulle, Ouvrages souterrains : conception, réalisation, entretien, Presses de l'Ecole Nationale des Ponts et Chaussées*
3. *K. Szechy, Traité de construction des tunnels, Dunod.*
4. *Cherchali, Tunnels, Tomes 1, 2, 3, 4 et 5, édition OPU.*
5. *F. Martin, 2012, Mécanique des Roches et Travaux Souterrains, Cours et exercices corrigés*

Semester 3
Teaching unit: UEF 2.1.2
Subject: Railways
VHS: 45 hours (lesson: 1 hour 30 minutes, tutorial: 1 hour 30 minutes)
Credits: 4
Coefficient: 2

Course Objectives:

This course aims to define all the elements and characteristicsnecessary for the geometric design and dimensioning of railwaytracks and their maintenance.

Recommended Prior Knowledge:

Roads, soilmechanics, drawing, topography.

Course Content:

Chapter 1: General Information and Reminders(1 Week)

Rail transport, advantages and disadvantages, trafficcategories. Necessarysteps for the study of a railway line, executionproject.

Chapter 2: Railway Infrastructure (3 Weeks)

Introduction to the railwaytrackbed, differentbedlayers, and design of the bed structure.

Chapter 3: Railway Superstructure (2 Weeks)

Rail, fishplates, sleepers (role of sleepers), fasteners

Chapter 4: TrackMechanics and Laying (1 Week)

TrackLoads, TrackLaying, Rail Length, Rail Joints, Travel.

Chapter 5: Elements of the Layout (5 Weeks)

Plan layout, Superelevation, Clothoid and Parabola parameters, Connectionlength, Longitudinal profile, Acceleration, Vertical radius, Main parameters for choosing the longitudinal profile (calculation and standards), Vertical connectionelements (Tangent, Bisector).

Chapter 6: Stations (1 Week)

Passenger Stations, Passenger Station Equipment, Freight Station, Station Facilities

Chapter 7: RailwayTrack Maintenance (2 Weeks)

Track Maintenance, Track Equipment Maintenance, Track and Track Equipment Renewal.

AssessmentMethod:

Mini Project (calculations and drawing): 40%; Exam: 60%.

BibliographicReferences

1. *UnioninternationaledescheminsdeferUIC703R*
2. *ConceptiondutracédelavoiecouranteVк220km/h(version1du12/09/06 SNCF) Fiches U. I. C*
3. *703R:caractéristiquesdetracédesvoiesparcouruespardestrainsdevoyageurs rapides*
4. *741O:quaisdesvoyageurs-règlepourl'implantationdesborduresdesquaispar rapport à la voie (4 ème édition, décembre 2005)*
5. *719R:ouvragesenterreetcouchesd'assiseferroviaire.*

Semester: 3

Teaching unit: UEF 2.1.2
Subject: Airfields
VHS : 55H (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

To enable students to master the design and dimensioning of airport platforms, as well as their management, maintenance and renovation.

Recommended prior knowledge:

Routes, Soil mechanic

Content of the material:

Chapter 1: General information on 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 Roadways(4 Weeks)

design of flexible pavements, flat-rate method, optimized method.
design 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 sizing method (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.
Renovation and maintenance of aeronautical pavements.

Assessment 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: UEF 2.1.2
Subject: Pathology of civil engineering works
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

Provides some basic information on the condition of a structure, the degradation mechanisms and 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 subject:

Chapter 1: Pathology of concrete (carbonation, alkali reaction, internal sulfate reaction, chemical and biological attacks, etc.).
Chapter 2: Pathologies of metal bridges
Chapter 3: Pathologies of masonry bridges
Chapter 4: Pathologiesfoundations
Chapter 5: Auscultation Methods
Chapter 6: Repair of civil engineering structures (old and new methods)
Chapter 7: Monitoring and maintenance of civil engineering structures

Assessment 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: UEM 2.1
Subject: Advanced Geotechnics
VHS: 45H (Lecture: 1h30, Tutorial or Practical: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Become familiar with in situ testing for geotechnical reconnaissance.
Become aware of the difficulty in controlling soil behavior by introducing behavior laws in the static and dynamic case to enable the treatment of certain complex situations in terms of soil behavior.

Recommended prior knowledge:

MDS, Elasticity

Content of the subject:

Chapter 1 : Reminders and general information (3 weeks)

Earth thrusts and stops, plasticity and shear resistance of soils.

Chapter 2:Retaining structures and reinforcements against landslides (3 weeks)

Pre-dimensioning of retaining structures, Static and dynamic studies of earth pressure (RPOA or SETRA), Stability study (sliding, overturning, sliding circle), Reinforcement against sliding.

Chapter 3: Reinforced earth structures (2 weeks)

Design and implementation method, economic evaluation.

Chapter 4:In situ tests (3 weeks)

Static and dynamic penetrometer test, Pressuremeter test, Plate test, Electrical and seismic gammagraphy tests

Chapter 5:Soil behavior (2 weeks)

Static and dynamic case **,** Duncan's law, Cam Clay's law, Dynamic case – Liquefaction phenomenon

Chapter 6:The ballasted columns (2 weeks)

Definition, field of use, method of implementation 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.

Assessment method:

Continuous Assessment: 40%; Exam: 60%

Bibliographic references:

1. *Philipponnat and B. Hubert, Foundations and earthworks, Ed. Eyrolles, 1997*
2. *G. Frank, Calculation of shallow 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 of soil mechanics and foundations (Volume 2) Ed. Dunod 1983*
5. *A. Dhouib , F. Blondeau , Ballasted columns: implementation techniques, areas of application, behavior, justification, control, research and development axes, Presses des ponts, 2005.*

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

Teaching objectives:

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

Recommended prior knowledge:

Bridge design, structural dynamics, reinforced concrete, prestressed concrete, steel framework, elasticity, finite elements.

Content of the material:

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

Assessment method:

Continuous assessment: 100%

Bibliographic references:

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

Semester: 3
Teaching unit: UEM 2.1
Subject: Organization and site visits
VHS: (Practical work or site visit: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:
Allow students to:
- to acquire knowledge of 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:
Computer skills, knowledge of civil engineering and public works.

Content of the material:
The training team can choose, depending on the human and material resources available at the establishment and the number of students, between teaching practical work on site organization and IT management tools such as Ms Project or others (Part A) and/or carrying 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 construction site organization (4 weeks)
Internal organization of construction sites, Site installation, Site management, Commissioning, Organizational 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 equipment) **(2 weeks)**
PW4: Calculation of the forecast budget (Labor + Machine). **(2 weeks)**
PW5: Materials price evaluation. **(1 week)**

Part B: Site Visits
At a rate of 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 of the visit (requests, logistical means, etc.)
- Brief description of the site subject to the visit
- Explanation of construction site safety instructions
- Distribution of students into groups
- Reading the plans if available

✓ **After the visit**

Preparation of site visit reports by students divided into teams.The visit report should enable the teacher to check the work organization capacity of each team.

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

Assessment method:

Part A: Continuous assessment: 100%.
Part B: Visit Report: 100%

Bibliographic references:

(Books and handouts, websites, etc.).

Semester: 3
Teaching unit: UET 2.1
Subject: Documentary research and dissertation design
VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:
To give students the tools they need to research useful information and use it more effectively in their final year project. To help them navigate the various stages of writing a scientific document. To demonstrate the importance of communication and to teach them how to present their work 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 related 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: Selecting information sources (2 weeks)
- Type of documents (Books , Theses, Dissertations, 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 : Processing information (2 weeks)
- Work organization
- The starting questions
- Summary of the documents selected
- Links between different parties
- Final plan of the documentary research

Chapter I-5: Presentation of the bibliography (01 Week)
- Bibliography presentation systems (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 report (2 Weeks)

- Identify and delimit the subject (Summary)
- Problems and objectives of the dissertation
- Other useful sections (Acknowledgments, Table of abbreviations, etc.)
- The introduction (*Writing the introduction last)*
- State of the specialized literature
- Formulation of hypotheses
- Methodology
- Results
- Discussion
- Recommendations
- Conclusion and perspectives
- Table of Contents
- The bibliography
- The annexes

Chapter II- 2 : Writing techniques and standards (2 weeks)

- Formatting. Numbering of chapters, figures and tables.
- The cover page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling. Improvement of general language skills in terms of comprehension and expression.
- Save, secure, archive your data.

Chapter II-3 : Workshop: Critical study of a manuscript **(1 Week)**

Chapter II-4 : Oral presentations and defenses (1 Week)

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

Chapter II-5: How to avoid plagiarism ? **(1 Week)**

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

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

Assessment method:

Exam: 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. *A. Mallender Tanner, ABC of technical writing: user guides, instructions, online help, Dunod, 2002.*
4. *M. Greuter, How to write your dissertation or internship report well, L'Etudiant, 2007.*
5. *Mr. Boeglin, Reading and Writing at University. From the Chaos of Ideas to Structured Text. L'Etudiant, 2005.*
6. *Mr. Beaud, the art of the thesis, Editions Casbah, 1999.*
7. *Mr. Beaud, the art of the thesis, La découverte, 2003.*

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