الجمهورية الجزائرية الديمقراطية الشعبية
Peoples Democratic Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research
اللجنة البيداغوجية الوطنية لميدان العلوم والتكنولوجيا
National Pedagogical Committee for Science and Technology

# ACADEMIC MASTER HARMONIZED

# National programme

# Update 2022

| Field | Branch | Specialty |
|---|---|---|
| ***Sciences and Technologies*** | ***Civil Engineering*** | ***Structures*** |

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# مواءمة

# ماستر أكاديمي

# Update 2022

| الميدان | الفرع | التخصص |
|---|---|---|
| علوم وتكنولوجيا | هندسة مدنية | هياكل |

# I – Master's identity card

# Access conditions

| Field | Harmonised Masters | Licences giving access to the master | Classification according to the compatibility of the licence | Coefficient assigned to the licence |
|---|---|---|---|---|
| **Civil Engineering** | **Structures** | Civil engineering | **1** | **1.00** |
| | | Public works | **2** | **0.80** |
| | | Mechanical engineering | **3** | **0.70** |
| | | Other licenses in the ST field | **5** | **0.60** |

# II – Semester organisation sheets for the coursees of the speciality

## Semestre 1 : Master Structures

| Teaching unit | Matter | Credits | Coefficient | Weekly hour volume | | | Semester Volume of Hours (15 weeks) | Complementary Work in Consultation (15 weeks) | Mode of evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Entitled | | | **Course** | **TD** | **TP** | | | **Continuous monitoring** | **Exam** |
| Fundamental Unit<br>Code : UEF 1.1.1<br>Credits : 8<br>Coefficients : 4 | Structural Mechanics | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| | Dynamics of Structures 1 | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| Fundamental Unit<br>Code : UEF 1.1.2<br>Credits : 10<br>Coefficients : 5 | Reinforced Concrete Structures 1 | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| | Metallic Structures | 6 | 3 | 3h00 | 1h30 | | 67h30 | 82h30 | 40% | 60% |
| Methodological unit<br>Code : UEM 1.1<br>Credits : 9<br>Coefficients : 5 | Programming Complement | 4 | 2 | 1h30 | | 1h30 | 45h00 | 55h00 | 40% | 60% |
| | Experimental Methods | 2 | 1 | | | 1h30 | 22h30 | 27h30 | 100% | |
| | Innovative Materials and Durability | 3 | 2 | 1h30 | | 1h00 | 37h30 | 37h30 | 40% | 60% |
| Discovery unit<br>Code : UED 1.1<br>Credits : 2<br>Coefficients : 2 | Coursee of choice 1 | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| | Coursee of choice 2 | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| Transversale Unit<br>Code : UET 1.1<br>Credits : 1<br>Coefficients : 1 | Technical English and terminology | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| **Total semestre 1** | | **30** | **17** | **15h00** | **6h00** | **4h00** | **375h00** | **375h00** | | |

## Semestre 2 Master Structures

| Teaching unit | Matter | Credits | Coefficient | Weekly hour volume | | | Semester Volume of Hours (15 weeks) | Complementary Work in Consultation (15 weeks) | Mode of evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Entitled | | | **Coursee** | **TD** | **TP** | | | **Continuous monitoring** | **Exam** |
| Fundamental Unit Code : UEF 1.2.1 Credits : 10 Coefficients : 5 | Elasticity | 6 | 3 | 3h00 | 1h30 | | 67h30 | 82h30 | 40% | 60% |
| | Dynamics of Structures 2 | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| Fundamental Unit Code : UEF1.2.2 Credits : 8 Coefficients : 4 | Reinforced Concrete Structures 2 | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| | Foundations and Supports Structures | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| Methodological unit Code : UEM 1.2 Credits : 9 Coefficients : 5 | Finite Element Methods | 5 | 3 | 1h30 | 1h30 | 1h00 | 60h00 | 65h00 | 40% | 60% |
| | Metal Constructions Project | 4 | 2 | 1h30 | | *1h30 | 45h00 | 55h00 | *70% | 30% |
| Discovery unit Code : UED 1.2 Credits : 2 Coefficients : 2 | Coursee of choice 3 | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| | Coursee of choice 4 | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| Transversale Unit Code : UET 1.2 Credits : 1 Coefficients : 1 | Ethics, deontology and intellectual property | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| **Total semestre 2** | | **30** | **17** | **15h00** | **7h30** | **2h30** | **375h00** | **375h00** | | |

***** Les séances de TP de la matière « **Projet constructions métalliques** », sont des séances d'encadrement présentielles et se déroulent sous forme d'atelier. Elles ne seront pas comptabilisées autant que séances de travaux pratiques conventionnelles.

## Semestre 3 Master Structures

| Teaching unit | Matter Entitled | Credits | Coefficient | Weekly hour volume | | | Semester Volume of Hours (15 weeks) | Complementary Work in Consultation (15 weeks) | Mode of evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Coursee** | **TD** | **TP** | | | **Continuous monitoring** | **Exam** |
| Fundamental Unit Code : UEF 2.1.1 Credits : 10 Coefficients : 5 | Prestressed Concrete | 6 | 3 | 3h00 | 1h30 | | 67h30 | 82h30 | 40% | 60% |
| | Plasticity and Damage | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| Fundamental Unit Code : UEF 2.1.2 Credits : 8 Coefficients : 4 | Earthquake Engineering | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| | Special Structures | 4 | 2 | 1h30 | 1h30 | | 45h00 | 55h00 | 40% | 60% |
| Methodological unit Code : UEM 2.1 Credits : 9 Coefficients : 5 | Reinforced Concrete Structures Project | 6 | 3 | 1h30 | | *3h00 | 67h30 | 82h30 | *70% | 30% |
| | Structural Modeling | 3 | 2 | | | 2h30 | 37h30 | 37h30 | 100% | |
| Discovery unit Code : UED 2.1 Credits : 2 Coefficients : 2 | Coursee of choice 5 | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| | Coursee of choice 6 | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| Transversale Unit Code : UET 2.1 Credits:1 Coefficients : 1 | Literature Search and Brief Design | 1 | 1 | 1h30 | | | 22h30 | 02h30 | | 100% |
| **Total semestre 3** | | **30** | **17** | **13h30** | **6h00** | **5h30** | **375h00** | **375h00** | | |

***Les séances de TP de la matière « **Projet structures en béton armé** », sont des séances d'encadrement présentielles et se déroulent sous forme d'atelier. Elles ne seront pas comptabilisées autant que séances de travaux pratiques conventionnelles.

**Discovered units UED of (S1, S2, S3)**

Basket =Choose one matter of 3h00 (1h30 coursee and 1h30 TD) or 02 matter of 1h30 each.

1. Building
2. Miscellaneous roads and networks
3. Natural and technological risks
4. Public Procurement Code
5. Pathologies and rehabilitation of structures
6. Building thermics
7. General construction processes
8. Project planning and management
9. **Other**

## Semestre 4

Internship in a company sanctioned by a thesis and a defense..

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

**This table is given for information only**

**Evaluation of the Master Project**

- Scientific value (Jury's assessment) /6
- Writing of the Memorandum (Jury's assessment) /4
- Presentation and response to questions (Jury's assessment) /4
- Assessment of the supervisor /3
- Presentation of the internship report (Jury's assessment) /3

# III - Detailed program by matter for the S1 semester

**Semestre:1**
**Teaching unit: UEF 1.1.1**
**Matter 1:Structural Mechanics**
**VHS: 45h00 (Coursee: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the course:

The proposed program makes it possible to reinforce the student's knowledge in structural calculation, to acquire matrix and iterative methods aimed at solving hyperstatic systems.

## Connaissances Recommended prerequisites:

Concepts of applied mathematics, Resistance of materials.

## Content of the subject matter:

**Chapter 1::** Introduction sur l'analyse des structures **(2weeks)**

**Chapter 2 :** Relations différentielles, calcul des flèches et rotations, théorie du potentiel interne, Théorème de Castigliano, Énoncé de Menabrea **(3 weeks)**

**Chapter 3 :** Méthode des forces **(2 weeks)**
(Notion de liaison surabondante interne, méthodes de simplification de calcul: méthode du centre élastique, cas où la sollicitation est un déplacement généralisé, cas des variations de température)

**Chapter 4 :** Méthode des déplacements **(2 weeks)**

**Chapter 5 :** Méthodes itératives **(2 weeks)**

**Chapter 6 :** Poutres continues sur appuis élastiques **(2 weeks)**

**Chapter 7 :** Calcul des structures en arc **(2 weeks)**

## Mode of evaluation:

Continuous control: 40%; Examination: 60%.

## Bibliographic references:


1. *Résistance des matériaux appliquée, tome1, M.ALBIGES,CITBTP.*
2. *Résistance des matériaux, tome1,J. COURBON,Dunod.*
3. *Résistance des matériaux, V.FEODOSSIEV, MIR-Moscou*
4. *Structures analysis, A.GHALI, NEVILLE, BROWN, Spon -Press.*
5. *Problèmes de résistance des matériaux, MIROLIOUBOV, MIR-Moscou.*
6. *Analyse des structures, ARAM SAMIKIAN,Gaetan Morin.*
7. *Résistance des matériaux, KERGUIGNAS, Dunod.*
8. *Leçons sur la résistance des matériaux, tome3, E. DREFFUSS.*
9. *Problèmes de résistance des matériaux, tome1 et 2, GIET, Dunod.*
10. *Eléments de la résistance des matériaux, J. COURBON, Dunod.*

**Semestre:1**
**Teaching unit: UEF 1.1.1**
**Matière2:Structural Dynamics 1**
**VHS: 45h00 (Course: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the coursee:

The objective of this course is to present methods for the calculation and behaviour of structures subjected to dynamic loads. The study of vibrations of linear systems, and the response of a structure with one degree of freedom subjected to various types of loading (constant, periodic, impulse), in order to master the design of structures subjected to dynamic loading.

## Recommended prerequisites:

Resistance of Materials; Numerical Methods.

## Content of the subject matter:

**Chapter : 1** Introduction and generalists **(3 weeks)**

- Definition of a dynamic problem
(Dynamic loading, Dynamic structure or system, Degree of freedom of a system, Generalized coordinates
- General procedure of a dynamic analysis
(Modelling in dynamics, Formulation of the equation of motion, Solving the differential equations of motion, Interpretation and exploitation of results)

**Chapter 2 :** Single degree of freedom systems **(6 weeks)**

- Formulation of the equation of motion
- Free vibrations
(Undamped free vibrations, damped free vibrations, logarithmic decrement)
- Forced vibrations
(Harmonic excitation, Impulsive excitation, Any dynamic excitation)
- Response to the movement of a support
(Harmonic excitation of the support, Seismic excitation of the support)
- Response spectrum

**Chapter 3 :** Multi-degree of freedom systems **(6 weeks)**

- Formulation of the equations of motion
- Evaluation of matrices [M], [K], [C] and force vector {P}
(Stiffness matrix [K], Mass matrix [M], Damping matrix [C], External force vector {P})

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references :


1 ***J. BETBEDER-MATIBET et J.L. DOURY*** *Constructions parasismiques, Techniques de l'Ingénieur, traité Contruction.*
2 ***Clough P. W. et Penzien J.****., Structural Dynamics, Computers and Structures Inc, Berkeley, 2001*
3 ***Chopra, A.K****., Dynamics of Structures - Theory and Application to earthquake engineering, Prentice Hall, New Jersey*
4 ***RPA-99 (2004).*** *Règles Parasismiques Algériennes 1999. Centre National de Recherche Appliquée en Génie Parasismique, Alger.*
5 ***Filialtrault****, Éléments de génie parasismique et de calcul dynamique des structures, Presses internationales Polytechnique 1996.*
6 ***Eurocode 8*** *:Design of structures for earthquake resistance, European Committee for Standardization, NF EN 1998-1 Sept 2005*
7 ***EL. Wilson****, 3-D Static and dynamic analysis, Computers & Structures, 1996.*

**Semestre:1**
**Teaching unit: UEF 1.1.2**
**Matière1:Reinforced Concrete Structures 1**
**VHS: 45h00 (Course: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the coursee:

The objective of this course is to teach students the design and dimensioning of the various reinforced concrete structural elements in a building while respecting the various building regulations.

## Recommended prerequisites:

Résistance des matériaux, Béton armé

## Content of the subject matter:

**Chapter 1** : Calculation of slabs and mushroom floors **(3 weeks)**

- Description and construction of slab floors
- Description and constructional provisions of mushroom floors
- Calculation of slabs

(BAEL fixed method, Pigeaud method, Fracture line method)

**Chapter 2 :**Design of reinforced concrete frames under vertical loads **(3 weeks)**

- Introduction
- Distribution of vertical loads on crossbeams
- Calculation of portal frames using Caquot's method
- Combinations of loads and determination of maximum moments on beam supports and in spans

**Chapter 3 :**Calculation of portal frames under horizontal loads **(3 weeks)**

- Introduction
- Concept of the centre of torsion
- Distribution of horizontal level forces on the frames by the torsion centre method
- Calculation of portal frames under horizontal forces by the Muto method

**Chapter 4 :** Regulatory requirements for columns and beams **(3 weeks)**

- Combinations of actions (BAEL and RPA 99)
- Regulatory provisions for columns
- Regulatory provisions for beams

**Chapter 5.** Superficial foundations **(3 weeks)**

- Footing under wall; Insulated footing under column;
- Footings under posts; Basements.

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references:


1. *Reinforced and Prestressed concrete'; par FK KONG and RH EVANS; 3rd edition, Van Nostrand Reinhold international, London.*
2. *Reinforced Concrete Design'; par WH MOSELY and JH BUNGEY; Fourth edition, MacMillan*
3. *Traité de Béton Armé'; par R LACROIX, A.FUENTES et H THONIER; Editions Eyrolles, Paris.*
4. *'Pratique du BAEL' ; J.PERCHAT et J.ROUX ; Editions Eyrolles,Paris.*

**Semestre:1**
**Teaching unit: UEF 1.1.2**
**Matière2:Metal structures**
**VHS: 67h30 (Course: 3h00, TD: 1h30)**
**Credits: 6**
**Coefficient: 3**

## Objectives of the coursee:

On completion of this subject, the knowledge acquired should enable the student to correctly dimension the structural elements of a steel structure.

## Recommended prerequisites:

To attend this course, it is necessary to have knowledge of: the materials used in CM; the basis for calculating frameworks in CM; the strength classes of cross-sections; the design strengths of cross-sections and elements; the connections.

## Content of the subject matter:

**Chapter 1 :** Design and calculation of beam - column connections **(3 weeks)**
(Welded beam - column connection, beam - column connection with bolted end plate)
**Chapter 2** : Design and calculation of the column feet **(3 weeks)**
Pole feet articulated, Pole feet embedded)
**Chapter 3 :** Design and calculation of runways: **(2 weeks)**
(Classification of overhead cranes, Actions on the running girder, Calculation of the running girder, Braking beams, Shear strength of webs, Resistance of webs to transverse loads)
**Chapter 4 :** Mixed floors **(3 weeks)**
(Design and calculation of the composite beam, Calculation of the connection)
**Chapter 5 :** Structural steel structures **(2 weeks)**
(Industrial buildings in steel structure, Multi-storey buildings in steel structure)
**Chapter 6 :** Methods of analysis of steel structures **(2 weeks)**
(Classification of structures, Choice of the analysis method, Taking into account of imperfections in the calculation of stresses)

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references:


1. *J. MOREL : Calcul des Structures Métalliques selon l'EUROCODE 3.*
2. *P. BOURRIER ; J. BROZZETTI : Construction Métallique et Mixte Acier–Béton – Tomes 1 et 2 – EYROLLES.*
3. *Document Technique Réglementaire – DTR – BC 2.44 – Règles de Conception et de Calcul des Structures en Acier « CCM97 ».*
4. *Document Technique Réglementaire – DTR – BC 2-4.10 – Conception et Dimensionnement des Structures Mixtes Acier-Béton.*
5. *EUROCODE N°3 – Calcul des Structures en Acier – Partie 1-8 : Calcul des assemblages*

**Semestre:1**
**Teaching unit: UEM1.1**
**Matière1:Complementary programming**
**VHS: 45h00 (Course: 1h30, TP: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the coursee:

This course aims to deepen the students' knowledge in programming. It allows to acquire the notions of modular programming.

## Recommended prerequisites:

*General computing, programming languages*

## Content of the subject matter:

**Chapter 1.**Review of programming techniques and programme structuring**(3 weeks)**
**Chapter 2.** Use of procedures and functions **(4 weeks)**
**Chapter 3.** Modular programming **(4 weeks)**
**Chapter 4.** Application examples **(4 weeks)**

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references:


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

**Semestre:1**
**Teaching unit: UEM1.1**
**Matière2:Experimental methods**
**VHS: 22h30 (TP: 1h30)**
**Credits: 2**
**Coefficient: 1**

## Objectives of the coursee:

This course provides the student with some experimental tools for the rheological and mechanical characterisation of certain materials and their durability.

## Recommended prerequisites:

Construction materials taught at licence level

## Content of the subject matter:

**Chapter 1 :** Tests on self-compacting concrete in the fresh state **(5 weeks)**

- Abrams Cone Spreader
- L-box
- Sieve stability

**Chapter 2 :**Durability test on concrete **(5 weeks)**

- Chemical attacks
- Carbonation-induced corrosion

**Chapter 3 :**Mechanical testing of mortars and concretes and recovery of materials
Mortar and concrete with portland cement and cement substitutes **(5 weeks)**

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references:


1. *Association Française de Génie Civil (AFGC), Recommandations pour l'emploi des bétons auto-plaçants, Documents scientifiques et techniques, (2008).*
2. *Association Française de Génie Civil (AFGC), Conception des bétons pour une durée de vie donnée des ouvrages Documents scientifiques et techniques, (2004)*

**Semestre:1**
**Teaching unit: UEM1.1**
**Matière3:Innovative materials**
**VHS: 37h30 (Course: 1h30, TP: 1h00)**
**Credits: 3**
**Coefficient: 2**

**Objectives of the coursee:**
To provide the specific knowledge to undertake high level research work on new materials. To train for executive and/or expert functions in the field of materials research and development.

**Recommended prerequisites:**
Construction materials taught at licence level

**Content of the subject matter:**

**Chapter 1 :** Ecological materials **(3 weeks)**
- Use of materials :
- Natural materials (stone, clays for stabilised mud bricks, natural pozzolans)
- Activated materials (calcined clays: metakaolin, rice husk ash)
- Industrial by-products and wastes (Rubber aggregates, slag and LD, sediments, biomass ash: WWTP, animal meal, recycled glass)

**Chapter 2.** Alternative binders and substitutes **(4 weeks)**
- Organic binders: clay stabilisers
- Belitic binders
- Glass binders
- Geopolymers, inorganic polymers
- Natural and artificial pozzolans

**Chapter 3.** New materials **(4 weeks)**
- Self-compacting concrete (formulation and fresh state, hardened state and durability)
- Hemp concrete
- Fibre concrete

**Chapter 4.** Construction materials **(4 weeks)**
- Improvement of precast HPC, HPCM, HPCU processes
- Low pH concretes
- Injection grouting

**Mode of evaluation:**
Continuous control:40% ; Exam: 100 %.

**Bibliographic references:**
1. *Association Française de Génie Civil (AFGC), Recommandations pour l'emploi des bétons auto-plaçants, Documents scientifiques et techniques, (2008)*
2. *G. DREUX, Jean FESTA« Nouveau guide du béton et de ses constituants » Eyrolles, 1998*

**Semestre: 1**
**Teaching unit: UET1.1**
**Matière 1:Technical English & Terminology**
**VHS: 22h30 (Course: 1h30)**
**Credits: 1**
**Coefficient: 1**

## Objectives of the coursee:

To introduce the student to technical vocabulary. Reinforce their knowledge of the language. To help them understand and synthesise a technical document. To enable them to understand a conversation in English held in a scientific context.

## Recommended prerequisites:

Basic English vocabulary and grammar

## Content of the subject matter:

- Written comprehension: Reading and analysis of texts related to the speciality.

- Oral comprehension: From authentic video documents of scientific popularisation, note-taking, summary and presentation of the document.

- Oral expression: Presentation of a scientific or technical subject, elaboration and exchange of oral messages (ideas and data), telephone communication, gesture expression.

- Written expression: extracting ideas from a scientific document, writing a scientific message, exchanging information in writing, writing 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 present and explain about ten technical words of the specialty in the three languages (if possible) English, French and Arabic.**

## Mode of evaluation:

Exam: 100%.

## Bibliographic references :


1. *P.T. Danison, 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*
6. *T. N. Huckin, and A. L. 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 program by matter for the S2 semester

**Semestre:2**
**Teaching unit: UEF 1.2.1**
**Matière1:Elasticity**
**VHS: 67h30 (Course: 3h00, TD: 1h30)**
**Credits: 6**
**Coefficient: 3**

## Objectives of the coursee:

To provide students with calculation methods to analyse the mechanical functioning of structures, to design them soundly, to have the necessary basics to use the software.

## Recommended prerequisites:

Basic knowledge of mathematics, strength of materials.

## Content of the subject matter:

**Chapter 1**: Introduction to elasticity theory **(1 weeks)**
(General information on elasticity, Mathematical background, Index notation)

**Chapter 2:** State-of-stress theory **(3 weeks)**
(Stress tensor, Differential equations of equilibrium, Stress on a plane, Stress and principal directions, Geometric representation (Mohr's tri-circle)

**Chapter 3:** State of deformation theory **(1 weeks)**
(General, Strain Tensor, Relationship between Strain and Displacement, Strain and Principal Directions, Geometric Representation (Mohr's Tri-Circle), Strain Compatibility Equation, Strain Measurement)

**Chapter 4:** Stress-strain relationship and behaviour laws **(2 weeks)**
(Generalized Hooke's law, Influence of temperature, Deformation energy)

**Chapter 5:** General equations for linear elasticity **(2 weeks)**
(Lamé equations, Beltrami-Michell equations, Saint Venant principle.....)

**Chapter 6:** Solving problems of plane elasticity **(2 weeks)**
(AIRY function, plane strain problem, plane stress problem)

**Chapter 7:** Beam Flexion **(2 weeks)**

**Chapter 8:** Thin plate studies **(2 weeks)**

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references:


1. *Theory of Elasticity / Timoshenko et Goodier*
2. *Exercices d'élasticité / Caignaerd et J.P. Henry Editions: Dunod*
3. *Mécanique des structures (volume 2) / François Frey Edition : EPFL Press*
4. *Théorie des plaques et coques, Timoshenko Woinowsky-Krieger*
5. *Mathematical elasticity A. E. Love*
6. *Mécanique des milieux continus Tome 3 Plaques et coques*
7. *Theory of elasticity E. Green and W. Zerna.*
8. *Calcul des structures. COURBON (J.). Dunod (1972).*

**Semestre: 2**
**Teaching unit: UEF 1.2.1**
**Matière 2:Structural Dynamics II**
**VHS: 45h00 (Course: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the coursee :

The objective of this course is to teach the behaviour of civil engineering structures, making use of several methods, used in the dynamic analysis of civil engineering structures and constructions..

## Recommended prerequisites :

ROM; Structural Dynamics I; Programming Language; Numerical Methods.

## Content of the subject matter :

**Chapter 1:** Free vibration of M.D.F.S **(3 weeks)**

- Introduction
- Undamped free vibrations M.D.F.S (modal analysis)
- Orthogonality of eigenmodes
- Applications

**Chapter 2 :** Forced vibration of M.D.F.S. **(6 weeks)**

Modal superposition method
(Decoupling of differential equations, Solving decoupled differential equations, Superposition of modal responses, Applications)
- Modal spectral method
(Response and design spectrum, Calculation of modal seismic forces, Combination of modal responses, Applications)

**Chapter 3 :** Pushover method **(6 weeks)**

- Principle
- Definition of the structure and behaviour laws of the elastic nodes
- Definition of the lateral force distribution
- Determination of the seismic demand
- Non-linear static analysis of the structure
- Transformation to a single DDL equivalent system
- Capacity curve of the A-D structure and SSDL target displacement
- Determination of the target displacement for the multi-degree-of-freedom system and evaluation of the global and local demand
- Performance evaluation and damage analysis
- Application

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references :


1. ***J. BETBEDER-MATIBET et J.L. DOURY*** *Constructions parasismiques, Techniques de l'Ingénieur, traité Contruction.*
2. ***Clough P. W. et Penzien J.****, Structural Dynamics, Computers and Structures Inc, Berkeley, 2001*
3. ***Chopra, A.K.****, Dynamics of Structures - Theory and Application to earthquake engineering, Prentice Hall, New Jersey*
4. ***RPA-99 (2004).*** *Règles Parasismiques Algériennes 1999. Centre National de Recherche Appliquée en Génie Parasismique, Alger.*
5. ***Filialtrault****, Éléments de génie parasismique et de calcul dynamique des structures, Presses internationales Polytechnique 1996.*
6. ***Eurocode 8*** *:Design of structures for earthquake resistance, European Committee for Standardization, NF EN 1998-1 Sept 2005*
7. ***EL. Wilson****, 3-D Static and dynamic analysis, Computers & Structures, 1996.*

**Semestre: 2**
**Teaching unit : UEF 1.2.2**
**Matière1 : Reinforced Concrete Structures 2**
**VHS: 45h (Course: 1h30, TD: 1h30)**
**Credits : 4**
**Coefficient : 2**

## Objectives of the coursee :

The programme of the reinforced concrete structure subject (2) complements the same subject in S1. The student must be able to select and use the appropriate calculation methods for the design, dimensioning and reinforcement of the components of the structure.

## Recommended prerequisites :

ROM; Calculation of straight sections in reinforced concrete

## Content of the subject matter :

**Chapter 1 :** Calculation of secondary components **(3 weeks)**

( Stairways, balconies, Acroteria)

**Chapter 2 :** Brace systems **(5 weeks)**

Selection and general bracing of buildings by: portal frames, rigid walls, triangulated walls, concrete walls, stability cores and mixed solutions. Location and torsion of walls in structures. Principles of seismic design of buildings

**Chapter 3 :** Sails **(3 weeks)**

Types, Characteristics and Strength of Sails
Reinforcement of trumeaux and lintels

**Chapter 4 :** Deep foundations **(4 weeks)**

Footing on a pile, and several piles; General rafting

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references:


1. *Guerrin et R. C. Lavaur, « Traité de béton armé ; Ossatures d'immeubles et d'usines, planchers, escaliers, encorbellements, ouvrages divers du bâtiment, Tome 4 », Dunod, 1971.*
2. *Jean Pierre Mougin, « Béton armé, BAEL 91 modifié 99 et DTU associés », Eyrolles, 2000.*
3. *Règles BAEL 91, « Règles techniques de conception et de calcul des ouvrages et constructions en béton armé suivant la méthode des états limites », Eyrolles, mars 1992.*
4. *Georges Dreux, « Calcul pratique du béton armé. Règles BAEL 83 », 1983*
5. *Christian Albouy, « Eurocode 2: béton armé - éléments simples », CERPET – STI, 2007.*
6. *J. A. Calgaro, « Applications de l'Eurocode 2 - Calcul des bâtiments en béton », ponts et chaussée, 2007.*
7. *A.CHANTI, Contreventement des bâtiments par voiles. O.P.U.*
8. *ALBIGÈS (M.) et GOULET (J.). – Contreventement des bâtiments. Ann. ITBTP, mai 1960.*
9. *GRINDA (L.). – Calcul des voiles de contreventement des bâtiments à étages. Ann. ITBTP, 1967.*
10. *Coin A., Decauchy A. et Collignon J.P., Murs de contreventement à ouvertures multiples. An. ITBTP, 71.*
11. *Henry Thonier, Conception et calcul des structures en béton armé. Presse de l'école nationale des Ponts et Chaussées, volume 2, 3 et 4. Édition Eyrolles.*

**Semestre: 2**
**Teaching unit: UEF 1.2.2**
**Matière2:Foundations and Supports**
**VHS: 45h00 (Course: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the coursee:

This course will enable the student to know the different types of foundations and to determine their bearing capacity. It will also help the student to become familiar with the design and calculation of certain retaining structures and the stabilisation and reinforcement of sloping ground.

## Recommended prerequisites:

Soil mechanics subjects in semesters 4, 5 and 6 in the Civil Engineering Licence, Resistance of materials

## Content of the subject matter:

**Chapter 1 :** Review Soil shear strength **(2 weeks)**

- ntroduction to the mechanical behaviour of soils (Examples of shear failure, Mohr-Coulomb failure criterion, stress-strain under different consolidation and drainage conditions)
- Equilibrium limit state of Rankine, Boussinesq and Prandtl

**Chapter 2 :**Calculation of shallow foundations **(4 weeks)**

- Failure modes, Bearing capacity theory and bearing capacity calculation for different types of shallow foundations and different types of loading, Allowable stress calculation, Settlement calculation

**Chapter 3 :** Calculation of deep foundations **(4 weeks)**

- Types of deep foundations, Methods of execution and calculation of the bearing load of a single pile and a group of piles (Static method, Pile driving formula, Penetrometer and pressure meter tests), Positive and negative lateral friction, Calculation of the permissible stress, Deep foundation project

**Chapter 4 :**Supporting structures and reinforcement **(5 weeks)**

- Classification of Support Structures
- (Weight walls, Reinforced concrete walls, Sheet piling, Cast walls, Reinforced earth walls)
- Calculation of actions and stresses, Design and justification of retaining structures
- Introduction to the methods of reinforcement of sloping soils

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references :


1. G. Philipponnat et B. Hubert, Fondations et ouvrages en terre, Ed. Eyrolles, 1997
2. G. Frank, Calcul des fondations superficielles et profondes, Presses des ponts, 1999
3. J. Costet et G. Sanglerat, Course pratique de mécanique des sols (Tome2) Ed. Dunod 1983
4. G. Sanglerat, G. Olivari et B. Cambou, Problèmes pratiques de mécanique des sols et de fondations (Tome2) Ed. Dunod1983
5. F. Schlosser et P. Unterreiner, Renforcement des sols par inclusions, Ed. techniques de l'ingénieur, C245.

**Semestre: 2**
**Teaching unit: UEM 1.2**
**Matière 1:Finite element methods**
**VHS: 45h00 (Course: 1h30; TP: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the coursee:

The objective of this course is to teach the finite element method as a method for solving problems in Mechanics (Civil Engineering in particular) governed by partial differential equations with boundary conditions. The aim is to make the student understand how the method works in order to master its practice in a software (Numerical Modelling).

## Recommended prerequisites:

Numerical Methods; Resistance of Materials; Elasticity.

## Content of the subject matter:

**Chapter 1 :**Introduction and Objectives **(2 weeks)**

Review of the equations of equilibrium of an elastic solid
Exact solution and Approximate solution

**Chapter 2 :** Finite Elements in One Dimension **(5 weeks)**

- Spring Element (Stiffness matrix by direct method, Assembly, Boundary conditions, Resolution)
- Element Bar and Lattice System (Variational formulation (strong and weak), Element type (Interpolation function), Stiffness matrix by virtual work principle, Assembly, Transformation matrix boundary conditions, Resolution)
- Finite Element Beam and Portal (Variational formulation (strong and weak), Element type (Interpolation function), Stiffness matrix by potential energy minimisation, Assembly, Transformation matrix, Boundary conditions, Resolution)

**Chapter 3 :** Two and Three Dimensional Finite Elements **(6 weeks)**

- Interpolation and interpolation functions (3-node triangular element; 6-node triangular element; 4-node quadrangular element; 4-node tetrahedral solid element; 8-node rectangular solid element).
- Stiffness matrix construction (6-node triangular element; 4-node quadrangular element; 4-node tetrahedral solid element)
- Finite Element Plate Flexure

**Chapter 4 :**Dynamic Finite Elements **(2 weeks)**

- Construction of the finite element in One Dimension
- Generalization to two and three dimensional problems.

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references :


1. *Gouri Dhatt, Gilbert Touzot, Emmanuel Lefrançois « Méthode des éléments finis » hermes science publications-2004.*
2. Olek C Zienkiewicz, Robert L Taylor, J.Z. Zhu, The finite element method: its basis and fundamentals.ISBN: 978-1-85617-633-0-*Butterworth-Heinemann; 7 edition, 2013*
3. Jacob Fish, Ted Belytschko*A First Coursee In Finite Elements, Wiley, 2007*
4. *Christian Wielgozes Course et exercices de résistance de matériaux, élasticité-plasticité, éléments finis. ISBN-10: 2729879315 Ellipses, 2000.*

**Semestre: 2**
**Teaching unit: UEM 1.2**
**Matière: Metal construction project**
**VHS: 60h00 (Course: 1h30; TP: 2h30)**
**Credits: 5**
**Coefficient: 3**

## Objectives of the coursee:

The objective of the course is to direct the students to design and calculate a metal structure. The project will be in the form of a workshop where the teacher will direct the students to apply the different theoretical knowledge in steel structures to design and calculate a project. The practical sessions will be face-to-face sessions and will take place in a workshop format. They will not be counted as conventional practical sessions.

## Recommended prerequisites:

Steel construction, Metal structures.

## Content of the subject matter:

**Chapter 1 :**Collection and formulation of preparatory elements: **(2 weeks)**

(Project Data, Study Objectives, Regulatory Requirements, Building Product Data Sheets)

**Chapter 2 :** Design of a main frame to a hall building **(2 weeks)**

**Chapter 3 :**Design of roof and façade elements **(2 weeks)**

**Chapter 4 :**Assessment of snow and wind actions on the building **(2 weeks)**

**Chapter 5 :** Design of load-bearing roof and façade elements**(1 weeks)**

**Chapter 6:**Static analysis of transverse frames and design of main elements**(2 weeks)**

**Chapter 7 :** Design of Truss Bracing Systems **(1 weeks)**

**Chapter 8 :**Design and sizing of some connections **(2 weeks)**

**Chapter 9 :**Preparation of the graphic file for the execution works **(1 weeks)**

## Mode of evaluation:

Continuous control: 70 % ; Exam: 30%

## Bibliographic references :


1. *DTR BC 2.44, Règles CCM97 de conception et du calcul des structures en acier, édition du centre national CGS, Alger, 1998,*
2. *D.T.R 2-4.7, Règles définissant les effets de la neige et du vent sur les constructions "R.N.V.1999", édition du centre national CNERIB, Alger, 2000*
3. *Dahmani L., Calcul des éléments résistants d'une structure métallique, édition OPU, Alger, 2009,*
4. *Hirt M., Crisinel M., Charpentes Métalliques, Volume 11 du traité TGC, édition des Presses universitaires PPUR, Lausanne, Suisse, 2005*
5. *Morel J., Calcul des Structures Métalliques selon l'Eurocode 3, édition Eyrolles, Paris, 2005*
6. *Landowski M., Lemoine B., Concevoir et construire en acier, édition Arcelor, Luxembourg 2005.*

**Semestre : 2**
**Teaching unit : UET 1.2**
**Matière : Respect for norms and rules of ethics and integrity.**
**VHS : 22h30 (Course : 1h30)**
**Crédit : 1**
**Coefficient : 1**

**Objectives of the coursee:**

Developing students' awareness of the ethical principles and rules governing life at university and in the world of work. To make them aware of the respect and value of intellectual property. To explain to them the risks of moral evils such as corruption and how to combat them, to alert them to the ethical issues raised by new technologies and sustainable development.

**Recommended prerequisites :**

Ethics and deontology (the basics)

## Content of the subject matter :

## A.Respect for the rules of ethics and integrity,

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

**2. Research with integrity and responsibility**

- 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 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 unintentional plagiarism, detection of plagiarism, sanctions against plagiarists, ...). Falsification and fabrication of data.

**3. Ethics and deontology in the working world :**

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

## B- Intellectual property

**I- Basics of intellectual property**

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

**II- Copyright**

**1. Copyright in the digital environment**

Introduction. 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. Brevet**

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

**III- Protection and enhancement of intellectual property**

How to protect intellectual property. Infringement 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

**Mode of evaluation:**

Exam : 100 %

**Bibliographic references:**


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

21. Publication de l'université de Montréal, Stratégies de prévention du plagiat, Intégrité, fraude et plagiat, 2010.
22. Pierrick Malissard, La propriété intellectuelle : origine et évolution, 2010.
23. Le site de l'Organisation Mondiale de la Propriété Intellectuelle www.wipo.int
24. http://www.app.asso.fr/

# V - Detailed program by matter for the S3 semester

**Semestre:3**
**Teaching unit: UEF 2.1.1**
**Matière1: Prestressed concrete**
**VHS: 67h30 (Course: 3h, TD: 1h30)**
**Credits: 6**
**Coefficient: 3**

**Objectives of the coursee:**

The objective of this course is to provide students with the knowledge necessary to study pre-stressed and post-stressed concrete beams.

**Recommended prerequisites:**

Mathematics, ROM, MOC and reinforced concrete.

**Content of the subject matter:**

**Chapter 1 : General information on prestressed concrete (1 weeks)**
History, Introduction, Principle of prestressing, Advantages and disadvantages of prestressing.

**Chapter 2 :Materials and equipment used in prestressed concrete(1 weeks)**
Cement, Concrete, Prestressing reinforcement, Passive reinforcement.

**Chapter 3 :Prestressing Modes (2 weeks)**
Prestressing by pre-tensioning, prestressing by post-tensioning, other techniques.

**Chapter 4 :Prestress losses (3weeks)**
Instant and delayed post-tensioning losses, Pre-tensioning losses, Instant and delayed losses, Characteristic values of prestressing reinforcement tensions.

**Chapter 5 :Flexion of isostatic beams (3 weeks)**
General, Resistant sections, Actions and loads, Verification classes, ELS bending calculation, Important concepts, Calculation of sections in classes I and II, Calculation of sections in classes III, ELU bending calculation, Equilibrium of a section in ELU, Characterisation of an ultimate limit state, Principle of justifications, Equation of the problem, Other ultimate limit states

**Chapter 6 :Continuous beams on simple supports**: **(2 weeks)**
Calculation of hyperstatic prestressing loads by the internal method, Calculation of prestressing loads by the direct method

**Chapter 7: Tangent Stress Resistance (2 weeks)**
Shear force resistance, Effects of shear force, Shear force reduction, Shear stress calculation, Shear force check at SLE and ULS, Torsion resistance, Important concepts, Torsion behaviour of an AC or PC beam, Torsion check at SLE and ULS.

**Chapter 8: Justification of particular sections (1 weeks)**
Introduction, Support area, Post-tensioning introduction area, Pre-tensioning introduction area.

**Mode d'évaluation** :
Continuous control: 40%; Exam: 60%.

**Bibliographic references**:


1. Course pratique de béton précontraint par G.DREUX.
2. Construction en béton précontraint par Y.GUYON.
3. Le béton précontraint aux état limite par H.THONIER.
4. Course de béton précontraint par J.FAUCHET.
5. La précontrainte par Albert CHAUSSIN et R. LA CROIX.

**Semestre: 3**
**Teaching unit: UEF 2.1.1**
**Matière2:Plasticity and damage**
**VHS: 45h00 (Course: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

**Objectives of the coursee:**

The main objective of this course is to enable students to understand the tools for calculating civil engineering structures beyond their elastic limit, up to failure. The course deals with the consideration of the anelastic behaviour (plastic and/or damage) of materials in the evaluation of the behaviour of structures at failure. A link with the regulations is also established.

**Recommended prerequisites:**

Elasticity; Mechanics of Continuous Mediums; Resistance of Materials.

**Content of the subject matter:**

**Chapter 1. Introduction to anelastic design of structures** **(1 weeks)**

(Notion of behaviour laws, Need for plastic calculation)

**Chapter 2. Plastic design of structures** **(6 weeks)**

Plastic Traction
Plastic Flexion :
- Notions of plastic ball joint and Moment-curvature
- Study of homogeneous sections with axes of symmetry
- Study of reinforced concrete sections

Determination of capacity curves (Force-Displacement) of structures (trusses, beams, frames) by incremental analysis

**Chapter 3. Limit analysis applied to structural design** **(5 weeks)**

Principle of limit analysis
The theorems of limit analysis
- Static theorem
- Cinematic Theorem

Application to structural failure load calculations
Limit analysis and regulations (ELU, seismic design)

**Chapter 4. Endangerment** **(3 weeks)**

- Introduction to damage mechanics
- Damage to concrete and reinforced concrete structures
- Some damage models
- Structural damage (concept of damage index, local-global damage relationship)

**Mode of evaluation:**

Continuous control: 40%; Exam: 60%.

**Bibliographic references :**

- Milan Jirasek & Zdenek P. Bazant « Inelastic Analysis of Structures » Wiley. 2002.
- Patrick de Buhan « Élasticité et calcul à la rupture » Presses des ponts. 2007
- Jean Lemaître & Jean-Louis Chaboche « Mécanique des matériaux solides », 3ème édition Dunod. 2009.

**Semestre:3**
**Teaching unit: UEF 2.1.2**
**Matière1:Earthquake engineering**
**VHS: 45h (Course: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

**Objectives of the coursee:**

To provide students with knowledge of earthquake engineering so that the future manager will be able to use the usual methods of earthquake calculations, taking into account the regulations in force (RPA 99 - version 2003 and Eurocode 8-1).

**Recommended prerequisites**

Structural Dynamics 1 and 2, Reinforced Concrete Structures 1 and 2, Metal Structures.

**Content of the subject matter :**

**Chapter 1. Elements of seismology (2 weeks)**

- Causes of earthquakes,
- Seismic waves,
- Earthquake measurement systems,
- Seismic hazards, Case study.

**Chapter 2 : Objectifs de protection sismique et méthodes de conception(1 week)**

- Behavioural objectives
- Design methods
- Verification principles
- Design principles

**Chapter 3 : Characteristics of earthquake-resistant buildings (2 Weeks)**

- Basic design principles
  - Simplicity of structure
  - Uniformity, symmetry and hyperstaticity
  - Strength and stiffness in both directions, (effect of torsion)
  - Diaphragm action at floor level
  - Adequate foundations
- Regularity criteria of the structure
  - Regularity criteria in plan
  - Regularity criteria in elevation

**Chapter 4 : Criteria for classification (1 Week)**

- Seismic zones - zone acceleration coefficient
- Structures according to their importance
- Site locations - average dynamic amplification factor
- Bracing systems - global behavior coefficient of the structure

**Chapter 5 : Seismic force calculating requirements - Equivalent static method (3 Weeks)**

- Application conditions - Principle - Modelling
- Calculation of the total seismic force - Distribution of the seismic force according to height (floors)
- Accidental torsional effects
- Horizontal distribution of seismic forces to bracing elements - Safety justification - Action combinations
- Security justification - Action combinations

**Chapter 6 : Modal dynamic spectral method (3 Weeks)**

- Principle - Modelling - Design response spectrum - calculation of seismic forces.

- Requirements common to both methods:
  - Overturning stability.
  - Calculation of displacements.
  - Security justification.

**Chapter 7.Ductility Concept and Constructive Provisions (2 Weeks)**

- Concept of ductility and introduction to capacity design.
- Constructive provisions
  - Special requirements for structural elements.
  - Additional requirements for non-structural elements.

**Mode of evaluation:**

Continuous control: 40%; Exam: 60%.

**Bibliographic references:**

1- RPA-99, 2003. *Règles parasismiques Algériennes 1999*. Document technique réglementaire DTR-BC 248 - Centre National de Recherche Appliquée en Génie sismique (CGS), Alger, 90p.

2- Eurocode 8-1, Calcul des structures pour leur résistance aux séismes - Partie 1 : Règles générales, actions sismiques et règles pour les bâtiments, 2005.

3- DAVIDOVICI (V.). – *La conception parasismique commence dès le choix de la forme des bâtiments.* Les cahiers techniques du bâtiment, no 97, mars 1988.

4- Fuentes, A., 1988. *Comportement post-élastique des structures en béton arme.* Paris, édition Eyrolles, 124p.

5- André PLUMIER, constructions en zone sismique, Edition 2006, université de liège, Document téléchargeable sur le site du Département ArGEnCo : ww.ArGEnCo.ULg.ac.be.

**Semestre:3**
**Teaching unit: UEF 2.1.2**
**Matière2: Special Structures**
**VHS: 45h00 (Course: 1h30, TD: 1h30)**
**Credits: 4**
**Coefficient: 2**

## Objectives of the coursee:

This course deals with the design, dimensioning and reinforcement of certain non-building structures according to EuroCode EC2.

## Recommended prerequisites:

Resistance of materials, Reinforced concrete.

## Content of the subject matter:

**Chapter 1 :** Supporting walls **(3 weeks)**

**Chapter 2 :**Cupolas **(2 weeks)**

**Chapter 3 :**Silos **(3 weeks)**

**Chapter 4 :**Reservoirs and Water Storage **(3 weeks)**

**Chapter 5 :**Reinforced Concrete Bridges **(2 weeks)**

## Mode of evaluation:

Continuous control: 40%; Exam: 60%.

## Bibliographic references:


1. *Le béton armé selon les eurocodes 2 (Dunod 2010)*
2. *Calcul des structures en béton armé (Eyrolles 2013)*
3. *Dimensionnement des structures en béton selon l'eurocode 2(Le monitreur 2010)*
4. *Structures en béton armé (Eyrolles 2011).*

**Semestre:3**
**Teaching unit: UEM 2.1**
**Matière2:Structural modelling**
**VHS: 37h30 (TP: 2h30)**
**Credits: 3**
**Coefficient: 2**

**Objectives of the coursee:**

This course introduces the fundamental principles of modelling some civil engineering structures or elements of structures using finite element software (SAP, Robot Structural Analysis, ETABS ...).

**Recommended prerequisites:**

Basic principles of the finite element method, notions of reinforced concrete, notions on seismic and wind studies.

**Content of the subject matter:**

**Chapter 1.**Introduction to civil engineering software

**Chapter 2.** Steps in the modelling of a structure by the software;

**Chapter 3.** Modelling a reinforced concrete structure (residential or administrative building);

**Chapter 4.** Modelling of a metal frame structure (industrial shed).

**Mode of evaluation:**

Continuous control: 100%.

**Bibliographic references:**


- Document technique réglementaire (D.T.R. BC 2.2). Charges permanentes et charges d'exploitation.
- Règles parasismiques Algériennes RPA 99 version 2003. DTR –BC-2.48.
- Règlement neige et vent RNV 1999. DTR-C-2-4.7.
- Manuel d'utilisation du logiciel.

**Semestre:3**
**Teaching unit: UEM 2.1**
**Matière1: Reinforced Concrete Structures Project**
**VHS: 67h30 (Course: 1h30, TP: 3h00)**
**Credits: 6**
**Coefficient: 3**

**Objectives of the coursee:**

The objective of this course is to give students the opportunity to design and calculate a reinforced concrete structure project. It allows the application of knowledge in a design office situation. The teacher will supervise the students in face-to-face sessions. The practical sessions will take place in the form of workshops. They will not be counted as conventional practical work sessions.

**Recommended prerequisites:**

Resistance of Materials - Structural Mechanics - Plastic Analysis of Structures - MEF - Reinforced Concrete - Elasticity - Structural Modelling.

**Content of the subject matter:**

Presentation and description of the project
Presentation of the different stages of calculation of a project
Calculation assumptions
Materials used
Standards and regulations used
Choice of load-bearing system (mixed structures: walls + portals)
Pre-dimensioning of structural elements and evaluation of loads
Dimensioning of floors
Calculation of secondary elements (balcony, acroterion)
Calculation and reinforcement of stairs
Seismic study
Calculation and reinforcement of the load-bearing structure
Dimensioning of foundations.
Production of plans (formwork plan, reinforcement plan ....) for the calculated elements.
Conclusions and prospects

**Mode of evaluation:**

Continuous control: 70% ; Exam : 30%

**Bibliographic references:**

Reinforced and Prestressed concrete'; par FK KONG and RH EVANS; 3rd edition, Van Nostrand Reinhold international, London.
'Reinforced Concrete Design'; par WH MOSELY and JH BUNGEY; Fourth edition, MacMillan
'Traité de Béton Armé'; par R LACROIX, A.FUENTES et H THONIER; Editions Eyrolles,Paris.
'Pratique du BAEL' ;J.PERCHAT et J.ROUX ; Editions Eyrolles,Paris.
Beton arme calcul des ossatures ;Albert fuentes ; Editions Eyrolles,Paris.

**Semestre : 3**
**Teaching unit: UET 2.1**
**Matière 1 : Literature Search and Brief Design**
**VHS : 22h30 (Course: 1h30)**
**Credits : 1**
**Coefficient : 1**

**Objectives of the coursee** :
To provide the student with the necessary tools to search for useful information in order to better exploit it in his/her final project. To help them go through the different stages leading to the writing of a scientific document. To make the student aware of the importance of communication and to teach the student to present the work done in a rigorous and pedagogical manner.

**Recommended prerequisites :**
Editorial Methodology, Presentation Methodology.

**Content of the subject matter:**

**Part I : Documentary research:**

**Chapter I-1 : Definition of the subject (02 Weeks)**
- Title of the subject
- List of key words related to the topic
- Gather background information (acquisition of specialised vocabulary, meaning of terms, linguistic definition)
- Information sought
- Take stock of your knowledge in the field

**Chapter I-2 : Selecting information sources (02 Weeks)**
- Type of documents (Books, Theses, Dissertations, Periodical articles, Conference proceedings, Audiovisual documents...)
- Type of resources (Libraries, Internet...)
- Evaluate the quality and relevance of information sources

**Chapter I-3 : Find the documents (01 Week)**
- Search techniques
- Search operators

**Chapter I-4 : Processing information (02 Weeks)**
- Organisation of work
- The starting questions
- Synthesis of the selected documents
- Links between different parts
- 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...)
- Presentation of documents.
- Citation of sources

**Partie II : Conception of a brief**

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

- Identifying and defining the subject (Summary)
- Problematic and objectives of the thesis
- Other useful sections (Acknowledgements, Table of abbreviations...)
- The introduction (Writing the introduction last)
- State of the literature
- Formulation of hypotheses
- Methodology
- Results of the study
- Discussion
- Recommendations
- Conclusion and perspectives
- Table of contents
- Bibliography
- Appendices

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

- Formatting. Numbering of chapters, figures and tables.
- The cover page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling. Improving general language skills in terms of comprehension and expression.
- Saving, securing and archiving data.

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

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

- How to present a Poster
- How to present an oral communication.
- How to present a dissertation

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

- ( Expressions, sentences, illustrations, graphs, data, statistics,)
- Citation
- Paraphrasing
- Indicate the complete bibliographical reference

**Mode of evaluation:**

Exam : 100%

**Bibliographic references :**


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

7. *M. Beaud, l'art de la thèse, La découverte, 2003.*
8. *M. Kalika, Le mémoire de Master, Dunod, 2005.*