ULT Civil Engineering

Subjects Modules for S5

Semester 1 Year 3

U5.1: Structures & Works
Stability of the Works

Module designation	**Structures & Works**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.1
Subtitle, if applicable	-
Courses, if applicable	Stability of the Works
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dept. Head
Lecturer	Hatem Karoui
Language	French
Relation to curriculum	Professional Module, Compulsory
Type of teaching, contact hours	21h Classroom Lecture
Workload	Total 51 Hours (30 Hours of Self Study)
Credit points	2
Requirements according to the examination regulations	-Minimum Attendance rate : 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Soil Mechanics 1 & 2
Module objectives/intended learning outcomes	**Objectives:** Allow students to know the main types of building foundations and ensure the stability of structures **Intended learning outcomes** - Knowing how to size common structures resting on shallow or deep foundations - Be able to carry out the dimensioning of the retaining walls: Berlin walls, diaphragm walls, reinforced earth, nailing, sheet piling, gravity walls, reinforced concrete wall, etc. - Know how to deal with landslide calculation - Address the problems of the stability of sloping land

Content	**Classroom Lecture** **Chapter 1: Different categories of undergrounds** **Chapter 2: Geometric characteristics and longitudinal profile** 1. Railway tunnels 2. Road tunnels 3. Hydraulic galleries 4. Sanitation collectors **Chapter 3: Stability of underground structures** 1. Digging and stability 2. Theory of support and coating **Chapter 4: Operating equipment** 1. Venting 2. Lighting **Chapter 5: Digging the Underground** 1. Covered trenches 2. Underground digging **Chapter 6: Support** 1. Classification of support modes 2. Hangers 3. Bolting 4. Sprayed Concrete 5. Shield and prefabricated segments 6. Choice of a support mode **Chapter 7: Calculation of deep foundations** 1. Formwork 2. Concreting 3. Waterproofing of coatings
Study and examination requirements and forms of examination	Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	*REYNARD (P.) et REYNAUD (Ph). – Le système Robofore pour accroître la productivité des jumbos de foration. TOS no 105, mai/juin 1991.* *PUGLISI (R.) et BOUGARD (J.F.). – Le prédécoupage mécanique. TOS no 108, nov./déc. 1991.* *GUILLAUME (J.). – Le choix des paramètres et essais géotechniques utiles à la conception, au dimensionnement et à l'exécution des ouvrages creusés en souterrain. GT no 7. TOS no 123, mai/juin 1992.* *BRETZ (K.W.). – Les évolutions les plus récentes des machines d'excavation de tunnels par abattage avec brise-roche hydraulique dans les petites et moyennes sections. TOS no 113, sept./oct. 1992.* *LEFEBVRE (J.). – Réflexions sur l'informatisation de l'archivage et de l'exploitation des données pour les tunnels en service. TOS no 116, mars/avril 1993.* *GODARD (J.-P.). – Étude des coûts des infrastructures de transport ferroviaire en zones urbaines et suburbaines. GT no 15. TOS no 125, sept./oct. 1994*

U5.1: Structures & Works

Structure Dynamics

Module designation	Structure Dynamics
Module level, if applicable	3rd year
Code, if applicable	U5.1
Subtitle, if applicable	-
Courses, if applicable	Structure Dynamics
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Moez SELMI
Language	French
Relation to curriculum	Scientific Subject (Compulsory) To introduce Structure Dynamics Theory, and area of applications to students
Type of teaching, contact hours	42 hours, of Integrated Course (Classroom Lecture)
Workload	Total 84Hrs/Semester (42 hours of Self Study)
Credit points	3 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Resistance Of Materials, Theory Of Structures 1&2, Reinforced Concrete 1 & 2
Module objectives/intended learning outcomes	**Objectives :** 1. Study the dynamic behavior in the case of a free, harmonic, random oscillation. 2. Understand resonance phenomenon 3. Know the difference between a real response spectrum and a regulatory response spectrum. 4. Study the dynamic response by the modal superposition method. **Outcomes:** Student will be able to: 1. Determine the dynamic properties of a structure. 2. Design a structure under the effect of dynamic excitations 3. Determine the natural frequencies and the modes of vibration of a structures with Multiple-Degree-Of-Freedom (MDOF)

Content	**Chapter 1:** Introduction to the dynamics of structures **Chapter 2:** Free oscillations of a system with only Single Degree Of Freedom (**SDOF**) **Chapter 3:** Response of a Single Degree Of Freedom (**SDOF**) system to a harmonic excitation **Chapter 4:** Response of a Single Degree Of Freedom (**SDOF**) system to a random excitation **Chapter 5:** General introduction to the seismic phenomenon **Chapter 6:** Response spectra **Chapter 7:** System with Multi Degrees Of Freedom (MDOF): Determination of matrices characterizing the properties of a structure **Chapter 8:** Undamped free oscillations of a system with Multi Degrees Of Freedom MDOF **Chapter 9:** Study of the dynamic response by the method of modal superposition
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Practical Workshop Video projection,
Reading list	1. Dynamique des structures / Clough, Ray w, - 1980- D28 2. calcul dynamique des structures en zone sismique /Alain Capia – 1982 – D40 3. dynamique des structures en sismologie de l'ingénieur /Lucia Dobrescu – 1983 – D50-1 4. Aspects théoriques et numériques de la dynamique des structures / J. Donea – 1988 – D58

U5.1: Structures & Works
Finite Element Method FEM

Module designation	Structures & Works
Module level, if applicable	3rd year
Code, if applicable	U5.1
Subtitle, if applicable	-
Courses, if applicable	Finite Element Method FEM
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Moez SELMI
Language	French
Relation to curriculum	Scientific Subject (Compulsory) To introduce Finite Element Method, and area of applications to students
Type of teaching, contact hours	21 hours, of Integrated Course (Classroom Lecture) 21 hours of Practical Workshop
Workload	Total 63Hrs/Semester (21 hours of Self Study)
Credit points	2.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Continuum Mechanics basic theory
Module objectives/intended learning outcomes	**Objectives :** To master the tool and to understand the options offered by the software and the digital problems that may arise: 1. Understand the concepts of Mathematical Modeling of Engineering Problems. 1. Understand the Finite Element Method (FEM); 2. Understand the basic concepts of numerical modeling; **Outcomes:** Students will be able to: 1. Solve mechanical and physical problems using Finite Element Method ; 2. Apply knowledge of mathematics, science and engineering to the analysis of simple elastic structures using the finite element method. 3. Design and conduct numerical simulation, analyse and interpret the results.

Content	**Part I: Classroom Course:** **Chapter 1. Introduction to the Finite Element Method** **Chapter 2. Study of the strains:** -Description of the movement, -Strain tensor, -Displacement fields, -Linearized strain tensor, -Strains and main directions; **Chapter 3. Study of constraints:** -Fundamental laws of dynamics, -Conservation of the momentum, -Tensor of Cauchy constraints, -Equilibrium equations, -Boundary conditions, -Constraints and principal directions; **Chapter 4. Constitutive laws:** -Generalized Hooke's law, -Material isotropy, -Experimental identification -General methods of resolution: (Direct method, inverse method, plane problems); **Chapter 5. Energy theorems:** -Elastic strain energies, -Minimum theorems, -Kinematic and static approaches). **Part II: Project workshop:** **Project 1:** Use of the RDM6 & ABAQUS finite element software to solve 1D problem and comparison between Theoretical results. Example of problems: mechanical study of a beam in tension / compression, heat transfer through a wall **Project 2:** Use of the RDM6 &ABAQUS finite element software to solve 2D problem and comparison between theoretical results. Example of problems: mechanical study of different structures: slab, beam, dam.
Study and examination requirements and forms of examination	Format: Report and oral presentation of each project (40%) + Final written Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Practical Workshop in Laboratory Video projection,

Reading list	G. DUVAULT, Mécanique des Milieux Continus, Edition MASSON, Paris. 8 - J.OBALA , Exercices et Problèmes de Mécanique des Milieux Continus, Edition MASSON, Paris,(1981). - M.L.FARES, Principes Physiques du Comportement Mécanique des Matériaux, Publication de l'université de Annaba. - N. BOURAHLA, Résistance des Matériaux de Base, Université Saad Dahlab Blida, Edition GEOTEC. - S. BELKAHLA, Cours d'Elasticité Plasticité, Publication de l'université de Annaba. - O. RAHMANI, S.KEBDANI, Introduction à la Méthode des Eléments Finis pour les Ingénieurs, Edition OPU

U5.2: Public Projects & Quality
Quality Management

Module designation	**Public Projects & Quality**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.2
Subtitle, if applicable	-
Courses, if applicable	Quality Management
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dept. Head
Lecturer	xxxxxxxxxx
Language	French
Relation to curriculum	Professional Module, Compulsory
Type of teaching, contact hours	21 Classroom Lecture
Workload	Total 42 Hours (21 Hours of Self Study)
Credit points	1.5
Requirements according to the examination regulations	-Minimum Attendance rate : 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Corporate Management
Module objectives/intended learning outcomes	**Objectives:** To provide engineering students with a basic culture in the analysis and management of the Quality of Systems. Faced with an increasingly strong industrial concern, they will have to be made aware of the various issues and concepts, have knowledge of methods and tools from a core of 'classic' techniques: SPC, Quality Assurance, Audit, continuous improvement… **Intended learning outcomes** The engineering students should be able to analyse, understand and/or interpret the industrial situations with which they will be confronted, communicate usefully with the actors and experts in the field and, if necessary, supplement their knowledge by studying specialized works.

Content	**Classroom Lecture** **Chapter 1: Quality Management & Improvement:** 1. Introduction 2. Concepts and definitions 3. Historical 4. Place of Quality in Industrial Production **Chapter 2: Basic Quality Tools:** 1. Pareto analysis, 2. Cause-Effect Diagnosis, 3. Design of experiments, Taguchi, audit, review... **Chapter 3: The North American School of Statistical Control:** 1. Statistical Process Control (SPC), control charts, capability, 2. Performance evaluation, indicators, 3. Inter-company relations, sampling plans **Chapter 4: Quality Assurance:** 1. Concept of standards, Customer-Supplier Relations, ISO 9000) and Japanese standards (total confidence 2. Total Quality and continuous improvement tools) **Chapter 5: Towards industrial excellence:** 1. Process Approach 2. Evolution of standards…
Study and examination requirements and forms of examination	(100%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	1. Shiba S., Graham A., Walden D., '4 révolutions du management par la qualité totale', Dunod, 1998 2. Recueil de normes, 'Qualité et système de management ISO 9000', AFNOR, 2008 3. Pillet M., 'Appliquer la maîtrise statistique des processus MSP/SPC', Ed. d'org., 2005

U5.2: Public Projects & Quality

Health Safety Environment HSE

Module designation	**Public Projects & Quality**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.2
Subtitle, if applicable	HSE
Courses, if applicable	Health Safety Environment HSE
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dept. Head
Lecturer	Amine JALLEBI
Language	French
Relation to curriculum	Professional Module, Compulsory
Type of teaching, contact hours	21h Classroom Lecture
Workload	Total 51 Hours (30 Hours of Self Study)
Credit points	2
Requirements according to the examination regulations	-Minimum Attendance rate : 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Management de la qualité, Organisation des chantiers – Planification des travaux
Module objectives/intended learning outcomes	**Objectives:** - Empower the engineer on the construction sites, on the importance of respecting the rules of health and safety and to bring them to realize that safety on a construction site is the responsibility of all stakeholders **Intended learning outcomes** - Know the human, social, economic and legal issues related to health and safety on construction sites and the particularities of the construction sector. - Establish the causes of the most frequent accidents on a construction site and know how to intervene in the event of an accident
Content	**Classroom Lecture** **Chapter 1: Health Safety Environment HSE Plan** 1. Objectives 2. Roles and missions 3. Improvement process 4. Related regulations **Chapter 2: Risks on site and means of intervention** **Chapter 3: Main registers to be kept on site** **Chapter 4: Respect for the environment**

Study and examination requirements and forms of examination	Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	*[1] S. Gramond, La fonction sécurité, collection activité et sécurité, 3eme Edition, 2014.* *[2] A. Laurent, Sécurité des procédés chimiques, 2eme Edition, 2011.* *[3] N. Morgossian, Risque chimique, aide mémoire, 2eme Edition, 2006.* *[4] J.P. Mouton, La sécurité en entreprise, 2eme Edition, 2006.* *[5] A. Laurent, Sécurité des procédées chimiques, 2eme Edition, 2011.* *[6] A. Bernillon, O. Cerutti, Les outils du management de la qualité, le guide du gestionnaire,* *1995.*

U5.2: Public Projects & Quality

Public Procurement Process

Module designation	Public Projects & Quality
Module level, if applicable	3rd year
Code, if applicable	U5.2
Subtitle, if applicable	-
Courses, if applicable	Public Procurement Process
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Chedlia ADOUANI
Language	French
Relation to curriculum	Professional Subject (Compulsory) To introduce Public Procurement Process to students.
Type of teaching, contact hours	21 hours, of Integrated Course (Classroom Lecture)
Workload	Total 51 Hrs/Semester (30 hours of Self Study)
Credit points	2 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	General Knowledge about Public Projects
Module objectives/intended learning outcomes	**Objectives:** -Learn the administrative procedures and legal process of civil engineering sourcing or procurement projects **Key learning outcomes** Student will be able to : 1. Understand the strategic sourcing process 2. Identify the relationships that the sourcing team need to establish with internal and external stakeholders. 3. Identify the tools and resources that are appropriate at each phase of the strategic sourcing process. 4. Relate strategic sourcing and category management to the end-to-end procurement process.

Content	**Chapter 1. Stakeholders,** **Chapter 2. Mode of call for competition,** **Chapter 3. Forms of Sourcing or Procurement,** **Chapter 4. Contract documents,** **Chapter 5. Starting of work, monitoring of work, end of work,** **Chapter 6. Guarantee and insurance,** **Chapter 7. Contract litigation**
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT)
Reading list	https://www.letsbuild.com/fr/blog/processus-de-gestion-de-projet-de-construction

U5.3: Modelling & Applications
Case Study (CAD)

Module designation	**Modelling & Applications**
Module level, if applicable	3rd year
Code, if applicable	U5.3
Subtitle, if applicable	-
Courses, if applicable	Case Study (CAD)
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Khalil FRADI
Language	French
Relation to curriculum	Professional module (compulsory) Combination of tools to work on case study,
Type of teaching, contact hours	30 hours of Practical Workshop 12 hours for project
Workload	Total 56Hrs/Semester (14 hours of Self Study)
Credit points	2 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	CAD 1 & CAD 2
Module objectives/intended learning outcomes	**Objectives :** 1. Learn how to size reinforced concrete structures 2. Learn how to size reinforced metal structures. **Outcomes:** Students will be able to: 1. Design projects of reinforced concrete and metallic structures 2. Use design tools in all steps of the projects 3. Make the necessary analysis and optimization of results
Content	**Case Study Using AutoCAD, ARCHE, & ROBOT Software:** 1. Reading of the architectural plan on AutoCAD 2. Design the formwork and foundation plan 3. Calculate structural elements manually 4. Use of the ARCHE software, to size the elements of a reinforced concrete structure, 5. Use of the ROBOT software to dimension reinforced concrete structures and metal structures
Study and examination requirements and forms of examination	-Practical exam (100%) -Report for each project, exercise to be submitted and evaluated. -Final assessment at the end of the semester
Media employed	Video Projector, Demo & Tutorials in Computer Lab
Reading list	Autodesk Guides and Tutorials

U5.3: Modelling & Applications
Structure Simulation & Analysis

Module designation	**Modelling & Applications**
Module level, if applicable	3rd year
Code, if applicable	U5.3
Subtitle, if applicable	****
Courses, if applicable	Structure Simulation & Analysis
Semester (s) in which the module is taught	1st semester (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Hedi Ayed LAKHAL
Language	French
Relation to curriculum	Practical Workshop- Compulsory Familiarize with Robot Software and Structure analysis.
Type of teaching, contact hours	30 hours, practical workshop in Lab 12 hours for projects
Workload	Total 56 Hrs/Semester (14 hours of Self Study)
Credit points	2 credits
Requirements according to the examination regulations	-Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Metallic Construction, Reinforced Concrete 1 & 2, CAD, Revit
Module objectives/intended learning outcomes	**Objectives :** 1. Understand advanced building simulation and analysis capabilities for large complex structures. 2. Understand a smooth workflow, allowing faster simulation and analysis of a variety of structures 3. Hands on experience on basic functionalities of 3D modeling and calculations under Robot Structural Analysis 4. Master the basic options and settings of Robot Structural Analysis Professional **Outcomes:** Students will be able to: 1.Carry out a modeling and calculation project of a complex structure, with the functions of 3D modeling, application of supports and loads,

Content	**Part A : Workshop in Lab** **Chapter 1**- Robot Software configuration **Chapter 2**- Definition of the moduli of the structure -Type of structure available, -Mesh and construction line, -Creation of bars, -Creation of panels, -Definition of supports and releases, -Loads, -Combination of loads **Chapter 3**- Calculation, verification of assembly and analysis of results **Chapter 4**- Generate a complete calculation note **Chapter 5**- Examples illustrated during the training -Study of a 2D gantry, -Study of a 3D structure **Part B: Projects** Group Project are proposed
Study and examination requirements and forms of examination	-Practical & Oral exam (100%) -Report for each project, exercise to be submitted and evaluated. -Final assessment at the end of the semester
Media employed	Course Material (Hard/ Soft copy) for Practical workshop Video projection
Reading list	Autodesk Guides and Tutorials for Robot Software Tools

U5.3: Modelling & Applications

Roads & Various Networks RVN

Module designation	Modelling & Applications
Module level, if applicable	3rd year
Code, if applicable	U5.3
Subtitle, if applicable	
Courses, if applicable	Roads & Various Networks RVN
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Ines BOUSSETTA
Language	French
Relation to curriculum	Professional Subject(Compulsory) To introduce Roads & Various Networks, classification, implementations to students
Type of teaching, contact hours	15 hours, of Integrated Course (Classroom Lecture) 6 hours for project
Workload	Total 51 Hrs/Semester (30 hours of Self Study)
Credit points	2 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Construction General Process, Hydraulics & Hydrology, Road Engineering 1&2
Module objectives/intended learning outcomes	**Objectives :** 1. Learn about the regulations and basic techniques for carrying out Roads & Various Networks RVN projects **2.** Acquisition of notions of roads and various networks: Earthworks, DWS networks, Domestic wastewater treatment networks, rainwater networks, Electric networks, roads. **Outcomes :** Students will be able to : 1.Work on Roads & Various Networks RVN projects 2. Contribute effectively within a team in order to resolve all issues (Legal, Land survey's, and Equipment identification)

Content	1. Definition of the term Roads & Various Networks RVN, 2. Road geometry and structure, 3. Road accessories: curbs, gutters, signage, 4. Wastewater and rainwater purification networks: types and nature of effluents, alternative technologies in sanitation, 5. various networks: drinking water, electricity, gas ... **Project:** **Presentation of the Computer tool for sizing RVN.** : development of an RVN project taking into account topographical, hydrological and environmental constraints
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (25%) + Project Oral Presentation (25%)+ Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection,
Reading list	Livres et polycopies, sites Internet, etc.

List of Electives:

Elective Unit 1: Building Technique	Module 1: Reinforced Concrete 3
	Module 2: Dimensioning of special structures
	Module 3: Metallic Construction 2
Elective Unit 2: Bridges & Roads	Module 1: Tunnels & Dams Engineering
	Module 2: Prestressed Concrete 2
	Module 3: Art Works 2

U5.4 Elective Unit 1: Building Techniques
Reinforced Concrete 3

Module designation	**Elective Unit 1 : Building Techniques**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.4
Subtitle, if applicable	-
Courses, if applicable	Elective Module 1 : Reinforced Concrete 3
Semester (s) in which the module is taught	Semester 5
Person responsible for the module	Dept. Head
Lecturer	Sami ANTIT
Language	French
Relation to curriculum	Elective Professional Subject
Type of teaching, contact hours	42 Classroom Lecture
Workload	Total 84 Hours (42 Hours of Self Study)
Credit points	3
Requirements according to the examination regulations	-Minimum Attendance rate : 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Reinforced Concrete 1 & 2
Module objectives/intended learning outcomes	**Objectives:** Address the specificities of Eurocode 2: instabilities, compound bending, etc. **Learning Outcomes:** Students will be able to: 1. Address the specificities of Eurocode 2: instabilities, compound bending 2. Treat punching, fatigue problems 3. Know how to deal with serviceability limit states (ELS) of deflection, crack opening
Content	**Classroom Lecture** **Chapter I: Structural Analysis** **Chapter II: Construction provisions: curved anchoring** **Chapter III: Compound flexion, torsion** **Chapter IV: Calculation of crack openings** **Chapter V: Calculation of Fatigue and Fire Resistance**
Study and examination requirements and forms of examination	Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection

Reading list	*Bosc, J.-L. (2005). Dimensionnement des constructions selon l'eurocode 2 à l'aide des modèles bielles et tirants, principes et applications. Presses de l'ENPC.* *Calgaro, J. & Cortade, J. (2005). Applications de l'Eurocode 2, calculs des bâtiments en béton. Presses de l'ENPC.* *Coin, A. & Bisch, P. (2008). Conception des murs en béton selon les eurocodes, principe et application (Collection mécanique et matériaux ed.). Presses ENPC.* *Hurez, M., Juraszek, N., & Pelcé, M. (2009). Dimensionner les ouvrages en maçonnerie. AFNOR éd., Eyrolles.* *Paillé, J. (2009). Calcul des structures en béton. AFNOR éd., Eyrolles.* *Perchat, C. & Roux, J. (2002). Pratique du BAEL 91, cours et exercices corrigés. Eyrolles.* *Renaud, H. & Lamirault, J. (1989). Précis de calcul béton armé. Dunod.* *Renaud, R., Jaccoud, J., Burdet, O., & Charif, H. (2004). Dimensionnement des structures en béton : aptitude au service et éléments de structures (Traité de génie civil ed.), 8. Presses Polytechniques et Universitaires Romandes.* *Roux, J. (2009a). Maîtrise de l'eurocode 2. Afnor ed., Eyrolles.* *Roux, J. (2009b). Pratique de l'eurocode 2. Afnor ed., Eyrolles.* *Thonier, H. (2006). Conception et calcul des structures de bâtiment, l'Eurocode 2 pratique. Presses* *ENPC.*

U5.4 Elective Unit 1: Building Techniques
Dimensioning of Special Structures

Module designation	**Elective Unit 1: Building Techniques**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.4
Subtitle, if applicable	-
Courses, if applicable	Elective Module 2: Dimensioning of Special Structures
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dept. Head
Lecturer	Sami ANTIT
Language	French
Relation to curriculum	Elective Professional Subject
Type of teaching, contact hours	21h Classroom Lecture
Workload	Total 51Hours (30 Hours of Self Study)
Credit points	2
Requirements according to the examination regulations	-Minimum Attendance rate : 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Béton Armé I & 2 – Théorie des structures
Module objectives/intended learning outcomes	**Objectives:** Be able to study and size reinforced concrete structures with complex shapes
Content	**Classroom Lecture** **Chapter 1: Retaining Walls** **Chapter 2: The Domes** **Chapter 3: Silos** **Chapter 4: Reservoirs and Water Tower** **Chapter 5: Reinforced Concrete Bridges** **Chapter 6: The Industrial Halls**
Study and examination requirements and forms of examination	Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection

Reading list	*1. A. Guerrin, Traité de Béton Armé, tome 6, Dunod (édition 1968 et suivantes)* *2. Henri Thonier, Conception et Calcul des Structures de Bâtiment, tome 5, Presse de l'ENPC (1998).* *3. Cahier des Clauses Techniques Générales, fascicule n° 74 : Construction des réservoirs en béton* *4. Norme NF EN 1992-3 : Eurocode 2 : Calcul des structures en béton, partie 3 : Silos et réservoirs* *5. Cahier des Clauses Techniques Générales, fascicule n° 62 - titre I - section I : Règles techniques de conception et de calcul des ouvrages et constructions en béton armé suivant la méthode des états limites - BAEL 91 révisé 99.* *6. DTU P06-002 : Règles NV 65 - Règles définissant les effets de la neige et du vent sur les constructions et annexes.*

U5.4 Elective Unit 1: Building Techniques
Metallic Construction 2

Module designation	Elective Unit 1 : Building Techniques
Module level, if applicable	3rd year
Code, if applicable	U5.4
Subtitle, if applicable	-
Courses, if applicable	Elective Module 3: Metallic Construction MC 2
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Wissem TAKTAK
Language	French
Relation to curriculum	Elective Professional Subject Continue to Study Metallic Construction, realization, and area of applications to students
Type of teaching, contact hours	42 hours, of Integrated Course (Classroom Lecture)
Workload	Total 84Hrs/Semester (42 hours of Self Study)
Credit points	3 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Metallic construction 1
Module objectives/intended learning outcomes	**Outcomes:** 1. Understand the calculation of elements subject to various stresses 2. Understand the phenomena of elastic instabilities 3. Understand typical design of an industrial hall in steel structures. **Outcomes:** Student will be able to: 1. Determine forces and stresses in bolted and welded connections 2. Calculate and design steel structures subjected to various stresses. 3. Work on design of the connection , the tension and compression members and the beam and roof truss in steel structure

Content	**Chapter 1. Calculation of elements subjected to various stresses:** 1. Calculation of elements subjected to compound bending. 2. Calculation of the elements subjected to deviated compound bending. **Chapter 2. Study of the phenomena of elastic instabilities.** 1. Study of the buckling of isolated columns. 2. Study of the buckling of columns belonging to a space portico. 3. Study of the buckling of lattice posts. 4. Study of beam discharge. 5. Study of the buckling of beams. **Chapter 3. Truss beams.** **Chapter 4. Industrial halls** 1. Design, 2. bracing and overall stability, 3. load distribution **Chapter 5. Protection of metal structures against corrosion.**
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection,
Reading list	M.A.HIRT et M. CRISINEL « Charpente métalliques, conception et dimensionnement des halles et bâtiments », Presse Polytechniques et Universitaire Romandes, 2001. J.MOREL « Structures Métalliques », EYROLLES, 1997.

U5.4 Elective Unit 2: Bridges & Roads
Tunnels & Dams Engineering

Module designation	**Elective Unit 2 : Bridges & Roads**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.4
Subtitle, if applicable	-
Courses, if applicable	Elective Module 1: Tunnels & Dams Engineering
Semester (s) in which the module is taught	Semester 5
Person responsible for the module	Dept. Head
Lecturer	Wassim MEJRI
Language	French
Relation to curriculum	Professional Module, Compulsory
Type of teaching, contact hours	42 Classroom Lecture
Workload	Total 84 Hours (42 Hours of Self Study)
Credit points	3
Requirements according to the examination regulations	-Minimum Attendance rate : 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Soil Mechanics 1 & 2, Reinforced Concrete
Module objectives/intended learning outcomes	**Objectives:** 1. Know the main types of dams, calculation principles, implementation and monitoring 2. Know the main tunnel engineering techniques and their constraints

Content	**Classroom Lecture** ***Part A-Dams Engineering*** **Chapter 1: History in Tunisia and in the world** **Chapter 2: Functions of dams:** 1. Energy, 2. Reservoir, 3. Regulation... **Chapter 3: Characterization:** 1. Geometry, 2. Geology, 3. Water **Chapter 4 Dam Design:** 1. Studies, 2. Strengths, 3. Calculations **Chapter 5: Typology: materials, shape, design, sealing, stability,** 1. Concrete gravity dams, RCC, arch dams, buttress dams 2. Rockfill and earth dams 3. Movable, needle dams **Chapter 6: Construction of a dam:** 1. Studies, 2. Out of water, 3. Excavation, 4. Foundation, 5. Body **Chapter 7: Dam monitoring:** 1. Instruments, 2. Aging, 3. Maintenance, 4. Disasters ***Part B- Tunnel Engineering*** **Chapter 1: Design Criteria** **Chapter 2: Definition of the structure** **Chapter 3: Choice of execution mode** **Chapter 4: Choice of support (AFTES*)** **Chapter 5: Digging method (choice attack section, explosives, point attack machine, tunnel boring machines)** **Chapter 6: Types of supports (bolts, arch, timbering, gunning)** **AFTES: Association Française des Tunnels et de l'Espace Souterrain*
Study and examination requirements and forms of examination	Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	*Les barrages, du projet à la mise en oeuvre, A. J. Schleiss, H. Pougatsch, ed PPUR* *Les barrages, conception et maintenance, ENTPE* *Les tunnels (techniques de l'ingénieur)* *Guide tunnel AFTES* *Documentation SETRA*

U5.4 Elective Unit 2: Bridges & Roads

Prestressed Concrete 2

Module designation	**Elective Unit 2: Bridges & Roads**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.4
Subtitle, if applicable	-
Courses, if applicable	Elective Module 2: Prestressed Concrete 2
Semester (s) in which the module is taught	Semester 5
Person responsible for the module	Dept. Head
Lecturer	Abdelmajid BOUABEN
Language	French
Relation to curriculum	Elective Professional Module
Type of teaching, contact hours	21 Classroom Lecture
Workload	Total 51 Hours (30 Hours of Self Study)
Credit points	2
Requirements according to the examination regulations	-Minimum Attendance rate: 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Reinforced Concrete 1&2, Prestressed Concrete 1, Resistance of
Module objectives/intended learning outcomes	**Objectives:** Discover the technology specific to prestressed concrete, then approach the sizing of common elements... **Learning Outcomes:** Students will be able to: 1. Discover the technology specific to prestressed concrete 2. Know the particularities of prestressed concrete within the framework of Eurocode 2 for materials, 3. Know how to carry out an ELS dimensioning 4. Be able to estimate and process ULS of sharpness, bending moment

Content	**Classroom Lecture** **Chapter I: Prestress losses** 1. Definition 2. Types of losses 3. Tension at the origin 4. Loss of voltage (post - voltage) **Chapter II: Dimensioning of prestressing** 1. Purpose of sizing 2. Verification diagram 3. Basic data 4. Approach to prestressing 5. Passage zone 6. Notion of critical section 7. Assessment of prestressing 8. Minimum section of concrete **Chapter III: Rationale for Common Sections** 1. Justification with respect to normal stresses 2. Justification with respect to tangent stresses 3. Construction provisions
Study and examination requirements and forms of examination	Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	*[1]. THONIER, H. « Le béton précontraint aux états limites ». Presses de l'école nationale des ponts et chaussées (1992).* *[2]. CHAUSSIN, R. et al. « La précontrainte ». Presses de l'école nationale des ponts et chaussées (1992).* *[3]. NAAMAN, A.E « Prestressed concrete analysis and design ». Mac Graw Hill (1983).* *[4]. FUENTES, J. « La précontrainte dans le bâtiment ». Eyrolles (1983).* *[5]. DREUX , G. « Pratique du béton précontraint ». Eyrolles (1975).* *[6]. LACROIX, R « Projet de béton précontraint ». Eyrolles (1981).* *[7]. FIP «Pratical design of prestressed concrete structures ». Recommendations FIP (1990).* *[8]. CHERAIT, Y «Le béton précontraint aux états limites ». OPU (2004).* *[9].GERWICK , B. « Construction of prestressed concrete structures ». Morris NY (1971).*

U5.4 Elective Unit 2: Bridges & Roads

Art Work 2

Module designation	**Elective Unit: Bridges & Roads**
Module level, if applicable	3rd year of engineering Cycle
Code, if applicable	U5.4
Subtitle, if applicable	-
Courses, if applicable	Elective Module 3: Art Work 2
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dept. Head
Lecturer	Maher CHAKHARI
Language	French
Relation to curriculum	Professional Module, Compulsory
Type of teaching, contact hours	42 Classroom Lecture
Workload	Total 42 Hours (42 Hours of Self Study)
Credit points	3
Requirements according to the examination regulations	-Minimum Attendance rate : 80% >20% of non-attendance= elimination for exams
Recommended prerequisites	Soil Mechanics 1 & 2, Reinforced Concrete – Art Work 1
Module objectives/intended learning outcomes	**Objectives :** 1. Know the different types of works and the problems of implementation 2. Address issues specific to industrial civil engineering **Learning Outcomes :** At the end of this module, students should be able to: - know how to approach the calculation of a bridge: the choice of technological options, its calculation flowchart and the various hypotheses relating to it.

Content	**Classroom Lecture** **Chapter 1: Calculation of main beams** 1. Coefficient of transverse distribution (CRT) 2. Determination of stresses in the main beams 3. Stresses due to permanent load 4. Stresses due to load AL. 5. Stresses due to pavement load. 6. Stresses due to load Bc. 7. Stresses Due to Warhead. 8. Computational Solicitations. 9. Peculiarity of the reinforcement of the main beams. **Chapter 2: Calculation of slabs** 1. Part A: Local bending 2. Part B: Global Bending 3. Part C: Specificity of the reinforcement in the slab **Chapter 3: calculation of supports** 1. Study of laminated elastomer bearings 2. Horizontal forces acting on the supports of a bridge 3. Distribution of the horizontal forces on the supports 4. Design combinations of piers and abutments **Chapter 4: Execution of foundations and bridges** 1. Foundations 2. Girder bridge decks 3. Decks of slab and portal bridges
Study and examination requirements and forms of examination	Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection
Reading list	*Ouvrages d'art – Mongi BENOUEZDOU Version 1 -2006 Tome 1, Tome 2 et Tome 3*

U5.5: Management

Lean Start-Up

Module designation	Management
Module level, if applicable	3rd year
Code, if applicable	U5.5
Subtitle, if applicable	-
Courses, if applicable	Lean Start-Up
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Manel DRIJ
Language	French
Relation to curriculum	Transversal Subject (Soft Skills-Compulsory), To introduce the Lean Concept for Start Up and help them prepare for their professional life.
Type of teaching, contact hours	21 hours Seminar & projects
Workload	Total 42Hrs/Semester (21 hours of Self Study)
Credit points	1,5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	Understanding of Start-up process
Module objectives/intended learning outcomes	**Objectives:** 1. Succeed in creating useful, efficient and prosperous Start-up's. 2. Minimize the bankruptcy rate of Start-up's, 3. Learn what CUSTOMERS really want, not what they say 4. Work through the five principles of the Lean Startup methodology on actual projects 5. Explore new products and services without losing your existing customers 6. Effectively communicate with key stakeholders to evaluate outcomes from applying Lean Startup methodology **Outcomes:** Students will be able to: 1. Use the Lean Startup approach in companies in order to create order not chaos by testing the vision continuously. 2. Use Lean Startup to establish customers in order to distribute product widely. 3. Use Lean Startup to progress in manufacturing which will be measured by the production of high quality goods. 4. Drive a startup-how to steer, when to turn, and when to persevere-and grow a business with maximum acceleration.

Content	**Seminars & Projects :** **CHAPTER 1: Creation of Startups and Economic Issues.** Concept of Creative Destruction. Platform economics. Glossary and definition. **CHAPTER 2: Project idea.** Inspiration, Perspiration, Innovation on the move. **CHAPTER 3: Business Creation and Fundamental Assumptions.** **CHAPTER 4: "Produce - Measure - Learn"** Feed-Back Loop **CHAPTER 5: PRODUCE,** Value Proposition, Atomic Unit and / OR Minimum Viable Product **CHAPTER 6: MEASURE,** Experiment, ... with Real Clients First-time adopters (earlyvangelists) **CHAPTER 7: LEARN,** Pivot OR Persist. **CHAPTER 8: A New Century of Management** **PART 2: PROJECTS:** HOW LEAN STARTUP WORKS **-Study of** the Toyota "lean approach to manufacturing", **-Study of** the development of a minimum viable product (MVP) **-Study of** a construction project using the Build - Measure – Learn
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (25%) + Project Oral Presentation (25%)+Final Exam (50%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video projection,
Reading list	1. The Lean Startup", Eric RIES, Crown Business USA, 2011 2. "Matchmakers. The new economics of multi sited platforms", David EVANS et Richard SCHMALENSEE, HBR Press

U5.5 Management

Land Law

Module designation	Management
Module level, if applicable	3rd year
Code, if applicable	U5.5
Subtitle, if applicable	-
Courses, if applicable	Land Law
Semester (s) in which the module is taught	Semester 5 (S5)
Person responsible for the module	Dr Issam Khezami
Lecturer	Olfa GHANAY
Language	French
Relation to curriculum	Transversal Subject (Soft Skills-Compulsory), To introduce the Land Law to Students and help they prepare for their professional life.
Type of teaching, contact hours	21 hours, of Integrated Course (Classroom Lecture)
Workload	Total 42Hrs/Semester (21 hours of Self Study)
Credit points	1.5 credits
Requirements according to the examination regulations	- Minimum attendance rate: 80% of the total contact hours >20 % of nonattendance = elimination for exams
Recommended prerequisites	General knowledge in propriety, and respective public administration
Module objectives/intended learning outcomes	**Objectives :** To help the student to know & Understand: 1. The definition of land property, ownership, registration 2. Go through several cases using law in force. **Outcomes:** Student will be able to: 1. Define and describe the content, the acquisition process and the property and real rights. 2. Define and describe the land register and its operation. 3. Resolve simple cases related to property or real rights. 4. Carry out an analysis on complex cases related to property and real rights by being able to propose an approach allowing a solution to be obtained.

Content	**Chapter I - Introduction to Land Law** 1. Definition 2. Features **Chapter II - The general regime of private land ownership** 1. Ownership by contract 2. Ownership by prescription **Chapter III - The land regime** 1. The cases of "Habous" lands 2. Agricultural land 3. Private and collective lands **Chapter IV- Land registration** 1. Definition and nature of registration: Compulsory registration and Optional registration 2. The registration procedure 3. The effects of registration and the rights of parties and third parties
Study and examination requirements and forms of examination	Format: Written Mid-term Exam (40%) + Final Exam (60%)
Media employed	Course Material (Hard/ Soft copy) for Classroom & Online (Moodle ULT) Video Projection and discussion
Reading list	1. La loi n° 74-53 du 10 juin 1974 relative au certificat de possession telle que amendée par les lois n° 81-13 du 2 mars 1981 et n° 2000-10 du 24 janvier 2000 2. Le décret du 18 juillet 1957 3. Article 22, 45 et 140 du code des droits réels 4. La loi n° 64-28 du 4 juin 1964fixant le régime des terres collectives a expressément reconnu un droit de propriété des terres au profit des collectivités qui les exploitent 5. Le décret-loi n° 64-3 du 20 février 1964 relatif à l'immatriculation foncière obligatoire 6. le Code des droits réels (articles 319-357) 7. La loi n° 2001-34 du 10 avril 2001 portant mise à jour des titres fonciers