
FOUNDATION MASTER

2023-2024

YEAR 1

MECHANICS

PROGRAMME SUPERVISOR(S):

Eric LE CARPENTIER



YEAR 1 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
BCM	Basics of continuum mechanics	3
CPD	Computer Programming and Data Analysis	3
EAE	Energetics and Environment	3
EMA	Engineering Materials	3
ENL1	English, Cultural and Business Environment	3
FRL1	French language	3
MAT1	Mathematics	3
PROJ1	Project	9

YEAR 1 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits
DAV	Dynamics and Vibrations	3
DBM	Design of Building Materials	3
DSS	Design of Special Structure	3
ENL2	English, Cultural and Business Environment	3
FRL2	French language	3
MAT2	Mathematics	3
MCE	Mechanics for Civil Engineering	3
PROJ2	Project	9

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

Basics of continuum mechanics [BCM]

LEAD PROFESSOR(S): Vito RUBINO

Objectives

Introduce the fundamental concepts of continuum mechanics, including the description of deformation and stress, the formulation of constitutive equations, balance laws and boundary value problems.

Course contents

- Introduction to tensor calculus
- Particle kinematics : Lagrangian and Eulerian descriptions
- Motions and deformations: definition of strain tensors
- Stress: Cauchy stress tensor, equation of equilibrium, simple states of stress
- Balance laws : mass, linear, angular momentum and energy
- Basic constitutive equations : linear elasticity, isotropy, Newtonian fluids.
- Boundary value problems in elasticity.

Course material

[1] Lai, W. M., Rubin, D. H., Rubin, D., & Krempl, E. Introduction to continuum mechanics. (Fourth Edition), Butterworth-Heinemann, 2010.

[2] Spencer, A. J. M., Continuum Mechanics, Dover Publications, 2004.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
null	3	12 hrs	6 hrs	0 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

Computer Programming and Data Analysis [CPD]

LEAD PROFESSOR(S): Hugues DIGONNET

Objectives

This course aims to provide students with basic knowledge of computer programming with Matlab, and to introduce more advanced tools for data analysis (visualization, statistical analysis, numerical methods).

Course contents

This course includes an introduction to the Matlab programming environment, the use of matrix variables and matrix manipulations. Scripts and functions are introduced, together with basic programming structures, conditions and loops. Graphics manipulation and statistical tools for data analysis are presented, and general programming rules and tips for efficient computations are provided.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	0 hrs	0 hrs	18 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

Energetics and Environment [EAE]

LEAD PROFESSOR(S): Georges SALAMEH

Objectives

Understand and master the major energy, climate and environmental challenges of this century. The students will have to master the fundamental concepts and the large orders of magnitude, know how to make "back of an envelope" calculations in order to quickly analyze a solution while developing finely-tuned critical thinking skills.

Course contents

Energy issues
 Climate issues
 Environmental Issues
 Introduction, factfulness, energy-climate exercises, carbon footprint calculation
 Mini simulation of energy transition scenarios
 "Climate fresk" workshop.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	14 hrs	4 hrs	0 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

Engineering Materials [EMA]

LEAD PROFESSOR(S): Guillaume RACINEUX

Objectives

Today, there are more than 100 000 materials available for product design. In the past, the low number of materials was a limit in design; today their great number is an opportunity for innovation.

To select a material, one needs:

- a good knowledge of materials families,
- a good understanding of their properties,
- a methodology to select the materials according to design requirements (specifications).

At the end of this course the students must be able to:

- know the different families of materials as well as their properties,
- select the right material according to the product specifications.

Course contents

Materials selection
Materials family
Metallics materials
Composites materials

Course material

- Engineering Materials, I & II, M.F. Ashby and D.R.H. Jones, Elsevier (4th edition), 2012.
- Materials Selection in Mechanical Design, Butterworth-Heinemann (4th edition), 2010.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
null	3	4 hrs	6 hrs	8 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

English, Cultural and Business Environment [ENL1]

LEAD PROFESSOR(S): David TROYA

Objectives

In this course, you will learn how to:

- Develop an understanding of inter-cultural communication
- Develop oral and written communication adapted to different contexts (mainly inter-cultural situations)
- Organize, lead and participate in a meeting
- Strengthen self-confidence and level of conviction
- Work on professional documents in English
- Acquire presentation skills
- Express feelings and practice assertiveness
- Develop active listening and understanding to reformulate, explain and argue
- Develop well-being at work and a sense of responsibility
- Negotiate, innovate and propose innovative solutions
- Enhance teamwork

Course contents

Those objectives will be achieved by doing:

- English: full range of practical communication language exercises (reading comprehension, listening comprehension, written expression, oral expression)
- Business English: introduction to marketing and business practices

Educational projects are adapted to the level of the group (scenarios, role plays, simulations).

Analysis of a short story or an extract of a novel in order to explain the cultural components of the text.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	0 hrs	30 hrs	0 hrs	0 hrs	0 hrs

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

French language [FRL1]

LEAD PROFESSOR(S): Astrid DE BRUYN

Objectives

Students will learn general French and develop language skills in oral and written comprehension and expression. After completing this course, students will be able to communicate in spoken and written French, in a simple but clear manner on familiar topics in the context of study, hobbies etc.

Another important goal of this course is to provide an introduction to French culture. At the end of course (60 hours), complete beginners can expect to achieve A1 level and some aspects of A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels.

Course contents

Being able to speak about oneself.

Speaking about daily life in France.

Speaking about projects during the year in France.

Speaking about French festivals, traditions and comparing with one's home country.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	0 hrs	30 hrs	0 hrs	0 hrs	0 hrs

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

Mathematics [MAT1]

LEAD PROFESSOR(S): Françoise FOUCHER

Objectives

The objective is to supplement students' knowledge of both the theoretical and practical use of mathematical tools required in advanced engineering. This course focuses on linear algebra, and vector differential and integral calculus.

Course contents

- 1- Vector spaces, linear mappings, matrices, linear systems, real and complex inner products, orthogonal projection, Gram-Schmidt orthogonalization
- 2- Eigenvalues and eigenvectors, eigenbases, diagonalization, triangulation, spectral radius, matrix norms, application to quadratic forms, application to the study of the stationary points of a multivariate function
- 3- Functions of several variables, differential operators, Taylor formulas, line integrals, multiple integrals

Course material

References: Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, 2010

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	18 hrs	0 hrs	0 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Autumn Semester

Project [PROJ1]

LEAD PROFESSOR(S): Loic MICHEL / Tugdual LE NÉEL

Objectives

Option mécanique:

The objective of the course is to prototype autonomously a mecatronics object, with a notion of corporate social responsibility.

Course contents

Project management
Computer aided design
Manual and computerized manufacturing
Prototyping
Industrialization

Course material

Monk, Simon. Programming Arduino: Getting Started with Sketches. New York: McGraw-Hill Education, 2016.
Olwen Wolfe, Paris, J!innove comme on respire ou Comment faire vivre notre capacite d'innovation, 2007.
Kalani Kirk Hausman, Richard Horne, 3D Printing For Dummies, 2014

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	9	0 hrs	0 hrs	0 hrs	60 hrs	0 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

Dynamics and Vibrations [DAV]

LEAD PROFESSOR(S): Vito RUBINO

Objectives

This course is dedicated to the characterization of the motion of point masses and rigid bodies, and the influence of external forces on the kinematics.

Two main aspects are treated for both point masses and rigid bodies: (i) the kinematic description of the movement (velocity, acceleration) ; (ii) the interplay between kinematics and external forces.

At the end of this course, the students will be able to:

- analyze the kinematics of point masses and rigid bodies
- compute the velocity and acceleration of point masses and rigid bodies
- write the equations of motion of point masses and rigid bodies by making use of Newton's Laws or principles of linear and angular momentum.

Course contents

The course will cover the following topics:

- Kinematics of point masses
- Dynamics of point masses
- Kinematics of rigid bodies
- Dynamics of rigid bodies
- Work, power and kinetic energy

Course material

Engineering Mechanics 3, Gross, Hauger, Schröder, Wall and Govindjee. Springer

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	8 hrs	10 hrs	0 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

Design of Building Materials [DBM]

LEAD PROFESSOR(S): Ahmed LOUKILI

Objectives

The course aims to give basic notions on construction materials and their uses in civil engineering works. Understanding the concept of building construction and collaboration principles process. The course will put the theoretical data into practical concepts by practical works in the Civil engineering laboratory

Course contents

This course will introduce the students to :

- construction process;
- general building materials, systems, and types of construction;
- Building Codes; and the collaborative building professions.
- Study of basic materials used in construction, including research of building product specifications

Course material

A. Nevill "Properties of concrete" Ed. Eyrolles

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	10 hrs	0 hrs	8 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

Design of Special Structure [DSS]

LEAD PROFESSOR(S): Syed Yasir ALAM

Objectives

Fracture mechanics of building materials
Fiber reinforced concrete

Course contents

Introduction to fracture mechanics
Fracture in porous quasi-brittle materials
Characterization of crack at different physical scales
Classical linear theory of mechanics
Structural Failure Based on Material Behaviour
Main concepts of Fracture Mechanics
Limitations of LEFM in Concrete
Nonlinear fracture mechanics
Use of Fiber reinforced Concrete
Typical properties of Fibers and Cement Matrix
Fiber-matrix bond
Mechanics of fiber reinforcement
Fabrication of FRC
Properties of fiber reinforced concrete
Applications of FRC

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	18 hrs	0 hrs	0 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

English, Cultural and Business Environment [ENL2]

LEAD PROFESSOR(S): David TROYA

Objectives

- Understand the general concepts of business English and marketing principles
- Build a professional project and explore international opportunities
- Develop strategies for inter-cultural practice
- Develop oral and written communication adapted to different contexts
- Organize, lead and participate in a meeting
- Work on professional documents in English
- Acquire a professional lexicon
- Understand the principles of corporate business models
- Acquire notions of corporate culture and values
- Develop well-being at work and a sense of responsibility
- Negotiate, innovate and propose innovative solutions

Course contents

- English: full range of practical communication language exercises
- Business English: exercises to explore in practice the areas of management and marketing

Educational projects adapted to the level of the group (scenarios, role plays, simulations).

Analysis of a short story or an extract of a novel in order to explain the cultural components of the text.

Projects in a professional context "Start-up simulation", "marketing assignment", "advertising assignment", etc.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	0 hrs	30 hrs	0 hrs	0 hrs	0 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

French language [FRL2]

LEAD PROFESSOR(S): Astrid DE BRUYN

Objectives

Students will learn general French and develop language skills in oral and written comprehension and expression. After completing this course, the students will be able to communicate in spoken and written French, in a simple but clear manner on familiar topics in the context of study, hobbies etc. Another important goal of this course is to provide an introduction to French culture. At the end of course (50 hours), complete beginners can expect to achieve A1 level and some aspects of A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels.

Course contents

Speaking about stereotypes
 Speaking about French icons and introducing one from one's home country
 Speaking about media (press, social networks)

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	0 hrs	30 hrs	0 hrs	0 hrs	0 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

Mathematics [MAT2]

LEAD PROFESSOR(S): Françoise FOUCHER

Objectives

The objective is to supplement students' knowledge of both the theoretical and practical use of mathematical tools required in advanced engineering. This course focuses on ordinary differential equations, probability and statistics.

Course contents

- 1- First-order ODEs: Euler's method, equations with separate variables, linear ODEs
- 2- Second order linear ODEs: homogeneous case, homogeneous case with constant coefficients, non homogeneous case, solution by variation of parameters
- 3- Higher order linear ODEs
- 4- Systems of first-order ODEs, constant coefficient systems
- 5- Probability, random variables, probability distributions
- 6- Vectors and sequences of random variables, independance, convergence in distribution, almost sure convergence
- 7- Statistics: point estimation and confidence interval

Course material

References: Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, 2010

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	18 hrs	0 hrs	0 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

Mechanics for Civil Engineering [MCE]

LEAD PROFESSOR(S): Benoit HILLOULIN

Objectives

The objective of this course is to give students' skills in theoretical and practical use of mechanical tools required in civil engineering. The first semester is dedicated to strength of materials backgrounds and basic mechanical concepts.

Course contents

Stress. Strain and deformation. Theory of elasticity. Hooke's law. Mohr's circles. Energy balance. Principle of virtual displacements. Traction. Tension and compression. Uniaxial problems. Castigliano's theorem. Menabrea's theorem. Static equilibrium. Strain energy. Deflections of beams. Frames and truss structures.

Course material

Stephen H. Crandall, Norman C. Dahl and Thomas J. Lardner, An introduction to the mechanics of solids, 2nd edition, McGraw-Hill Sciences, 1999, 604 p.

James M. Gere, Mechanics of materials, 8th edition, CENGAGE Learning Custom Publishing, 1056 p.

David W. A. Rees, Mechanics of Solids and Structures: Second Edition, 2nd edition, ICP, 848 p.

Russell C. Hibbeler, Mechanics of materials, 10th edition, Pearson, 2016, 896 p.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	12 hrs	6 hrs	0 hrs	0 hrs	2 hrs

Foundation Master - Mechanics

YEAR 1 - Spring Semester

Project [PROJ2]

LEAD PROFESSOR(S): Loic MICHEL / Tugdual LE NÉEL

Objectives

The objective of the course is to prototype autonomous

Course contents

Project management
Computer aided design
Manual and computerized manufacturing
Prototyping
Industrialization

Course material

Monk, Simon. Programming Arduino: Getting Started with Sketches. New York: McGraw-Hill Education, 2016.
Olwen Wolfe, Paris, J!innove comme on respire ou Comment faire vivre notre capacite d'innovation, 2007.
Kalani Kirk Hausman, Richard Horne, 3D Printing For Dummies, 2014

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	9	0 hrs	0 hrs	0 hrs	60 hrs	0 hrs