MASTER DYNAMIQUE DES FLUIDES, ENERGETIQUE ET TRANSFERTS (ENERGETIQUE, THERMIQUE)

IN BRIEF

Type of diploma : Master (LMD)
Ministry field : Sciences, Ingénierie et Technologies
Mention : Energétique, thermique

ACCREDITED ESTABLISHMENTS

* INSTITUT MINES-TELECOM
* UNIVERSITE TOULOUSE 3
* ISAE TOULOUSE
* INSA TOULOUSE

MORE INFO

ECTS credits : 120

Level : BAC +5

Type of education
* Formation continue
* Formation initiale
* Formation en alternance

Kind of education : Parcours

Presentation

Ce Master a pour objectif de former des :

- Ingénieurs études

- Ingénieurs recherche et développement

- Ingénieurs chargé d'affaires

- Ingénieurs chef de projet mécanique et énergétique

- Conseillers en maîtrise de l'énergie et développement durable

La mention de ce Master comprend 3 parcours. La description ci-dessous correspond au parcours Dynamique des fluides, Energétique et Transferts (DET).

Au cours de son cursus l'étudiant a acquis les connaissances suivantes :

- Développement de modèles et réalisation de calculs de tout ou partie de systèmes mécaniques et énergétiques en bureau d'études, service R&D en entreprise, laboratoire public ou privé.

- Conseil scientifique et technique sur les moyens, les méthodes et les techniques de valorisation et de mise en oeuvre de résultats d'études ou de recherche en mécanique et énergétique.

- Rédaction de cahiers des charges, réponse à appel d'offre, dimensionnement et chiffrage des installations, notamment dans le domaine de l'énergie lié au bâtiment.

- Veille scientifique et technique en mécanique et énergétique dans les domaines de l'aéronautique, l'espace, les transports, l'environnement, la santé, l'énergie et le bâtiment

- Dans les domaines de l'aéronautique, l'espace, les transports, l'environnement, la santé, l'énergie et le bâtiment, supervision et coordination d'un projet, d'une équipe

Ainsi que les compétences ou capacités attestées :

- Mettre en place les méthodes analytiques ou numériques de modélisation et de dimensionnement de tout ou partie de systèmes mécaniques et énergétiques, en mobilisant des connaissances théoriques approfondies dans les domaines de la mécanique (fluides, solides) et l'énergétique (thermodynamique, transferts thermiques) touchant aux domaines d'application tels que l'aéronautique, l'espace, les transports, l'environnement, l'énergie et le bâtiment

- Mener l'analyse critique des hypothèses d'un modèle de tout ou partie de systèmes mécaniques et énergétiques, pour en utiliser ou en développer un nouveau.

- Modéliser et simuler des systèmes fluides, solides, ou thermiques en utilisant les outils de calcul scientifique et les logiciels de simulations adaptés (dont Matlab, Fluent, Ansys, Nastran, Comsol).

- Mener l'analyse critique des résultats de la modélisation, de la simulation ou de la mesure.

- Sélectionner, tester et développer le cas échéant les techniques de métrologie adaptées au projet.

- Assurer la qualité environnementale d'un projet lié à l'énergétique de l'habitat en maîtrisant les normes et labels nationaux et internationaux, et mener des audits de performances énergétique et confort de l'habitat.

- Conduire une analyse réflexive et distanciée prenant en compte les enjeux, les problématiques et la complexité d'une demande ou d'une situation afin de proposer des solutions adaptées et/ou innovantes

- Conduire un projet (conception, pilotage, coordination d'équipe, mise en oeuvre et gestion, évaluation, diffusion) pouvant mobiliser des compétences pluridisciplinaires dans un cadre collaboratif

- Identifier, sélectionner et analyser avec esprit critique diverses ressources spécialisées pour documenter un sujet et synthétiser ces données en vue de leur exploitation

- Actualiser ses connaissances par une veille dans son domaine, en relation avec l'état de la recherche et l'évolution de la règlementation

- Evaluer et s'autoévaluer dans une démarche qualité

- S'adapter à différents contextes socio-professionnels et interculturels, nationaux et internationaux

- Rédiger des cahiers des charges, des rapports, des synthèses et des bilans,

- Communiquer par oral et par écrit, de façon claire et non-ambiguë, en français et dans au moins une langue étrangère, et dans un registre adapté à un public de spécialistes ou de non-spécialistes

- Utiliser les outils numériques de référence et les règles de sécurité informatique pour acquérir, traiter, produire et diffuser de l'information de manière adaptée ainsi que pour collaborer en interne et en externe

Training content

Plein temps pour les semestres 7, 8 et 9, le semestre 10 est un stage.

Organization

MASŦER DYNAMIQUE DES FLUIDES, ENERGETIQUE ET TRANSFERTS M2

Access conditions

Accès en 2ème année de Master : sauf cas de validation, l'accès en 2ème année de Master est subordonné à l'obtention des 60 premiers crédits du programme de Master dans un domaine compatible avec la formation. L'admission s'effectue sur dossier, en fonction des capacités d'accueil et sur critères exclusivement pédagogiques.

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

MASTER DYNAMIQUE DES FLUIDES, ENERGETIQUE ET TRANSFERTS M2

MORE INFO

ECTS credits : 60

Organization

- **M2 Dynamique des fluides, Energétique et Transferts**
  - **M2 DET Semestre 9**
    - **Choix Parcours M2 DET**

      Choice: 1 Among 1 :
      - **Parcours Fluides, Energétique et Procédés A (M2 DET)**
        - **Teaching Unit Prérequis**

          Choice: 1 Among 1 :
          - **Prérequis harmonisation A7**
            - **Subject DBGP : Dynamique des bulles, gouttes et particules**
            - **Subject MFIT : rappels de MkF et initiation à la turbulence**
            - **Subject Initiation Linux / Harm A7**
          - **Prérequis harmonisation N7**
            - **Subject Transfert de matière**
            - **Subject DIMRAC : Dimensionnement de réacteur**
            - **Subject Initiation Linux / Harm A7**

· Teaching Unit Tronc commun

· Subject PHET : Physique des écoulements turbulents incompressibles

· Subject DIPH : Ecoulements diphasiques

· Subject COMUL : Couplage multiphysique

· Subject MIPO : Transferts en milieux poreux

Pre-requisites

To take this lecture, it is compulsory to know some basics in physics, hydrostatics and hydrodynamics. Following notions must be understood :

— hydrodynamics at low Reynolds number (especially Poiseuille law)

— way to do local and integral balances

— isotropic diffusion of particles in a fluid (Brownian motion)

— thermal diffusion in homogeneous media

Objectives

1 Hydrostatics and transport at individual pore scale

Objectives: At the end of these lectures, you should be able to :

— explain the surface effects on small-scale hydrostatics

— demonstrate the main relations related to surface tension (Young, Jurin, Laplace)

— summarize the main coupled transfers through an individual pore (electro-osmosis, diffusioosmosis, ...)

— adapt previous notions to solve an unknown coupled transport phenomenon

2 Upscaling to porous media

Objectives: At the end of these lectures, you should be able to :

— describe some natural and artificial porous media

— define the Knudsen number

— define and explain the main properties of a porous media (porosity, tortuosity, saturation)

— explain the Representative Element Volume

— summarize the different upscaling methods for porous media

— compute the spatial average of a scalar field in a porous media

3 Hydrodynamic transport in a porous media

Objectives: At the end of these lectures, you should be able to :

— summarize and interpret the Darcy's law

— compute an estimation of the permeability of a porous media

— cite some experimental methods to measure permeability

— define the Klinkenberg effect

— apply the Darcy's law without neglecting inertia (Ergun's law)

— choose the good approach to assess the hydrodynamic transport in a porous media

4 Diffusion and dispersion in a porous media

Objectives: At the end of these lectures, you should be able to :

— name the different kind of dispersion mechanisms in a porous media

— write and apply the Fick's law

— demonstrate the Taylor's dispersion in a cylinder

— describe diffusion phenomenon in porous media

— write and interpret the advection-dispersion equation

— cite and describe some applications of dispersion in porous media

5 Thermal transfer in a porous media

Objectives: At the end of these lectures, you should be able to :

— cite and describe the three thermal transfer mechanisms in porous media

— summarize the conduction thermal transfer model

— interpret different models of equivalent conductivity

— differentiate natural and forced convection

— summarize the convection thermal transfer model

— define the Rayleigh and Nusselt numbers in porous media

Description

The aim of this lecture is to present some aspects of transport in porous media from pore scale to porous media scale. At pore scale, specific small-scale hydrostatics will be presented then electrokinetics

effects due to wall surface charge will be described. Then an overview of porous media description and properties will be proposed, followed with the upscaling methods to translate local transport equations

to global ones. The first application will be the hydrodynamic transport through a porous media with the Darcy's law derivation. Then some lectures will focus on dispersion and diffusion in porous media,

both about particles/molecular transport and heat transfer. This lecture will be decomposed in five parts with specific objectives spread on eleven 1h45 lectures.

Number of hours
19h25

Person(s) in charge
LIOT Olivier
olivier.liot@enseeiht.fr

Teaching method
En présence

Teaching language
English

· Teaching Unit Milieux Réactifs et Combustion

· Subject COMB : Combustion

· Subject BESM : BES Moteurs à pistons

· Subject TMRC : Transferts en milieux diphasiques et turbulents

· Teaching Unit Particules en Ecoulement

Pre-requisites

Notions of multiphase flows (dispersed flows)

Objectives

- know the physical processes involved in turbulent dilute and dense particle laden /granular flows

- simulate such flows

· Subject ECGP : Ecoulements gaz-particules

· Subject TEDT : Dispersion turbulente

· Subject MGRA : Milieux granulaires

Objectives

- know the industrial and environmental issues regarding granular media and granular flows

- know the physical processes in these flows

- compute granular flows

Description

I. Introduction - industrial and environmental issues

II. Microscopic description of a granular medium

III. Statics of a granular medium

IV. Granular flows

V. Numerical models for granular flows

· Teaching Unit Modélisation numérique (Parcours A)

· Subject MTSS : Modèles de turbulence pour les simul. num. stationn.

· Subject NEPT : Simulation d'un lit fluidisé

· Subject CODC : Simulation des écoulements industriels

· Teaching Unit Formation générale

· Subject Anglais 3HY et M2 DET semestre 9

Pre-requisites

None.

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En présence

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* Meyers, A. (2013). *Longman Academic Writing Series 5: Essays to Research Papers.* Pearson Education.

· Subject Développement Durable, RSE, Ethique

· Subject Gestion et management de projet

· Subject Entreprenariat

· Subject Conférences et soutenance de stage

· Parcours Fluides, Energétique et Procédés B (DET)

· Teaching Unit Prérequis

Choice: 1 Among 1 :

· Prérequis harmonisation A7

· Subject DBGP : Dynamique des bulles, gouttes et particules

· Subject MFIT : rappels de MkF et initiation à la turbulence

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both about particles/molecular transport and heat transfer. This lecture will be decomposed in five parts with specific objectives spread on eleven 1h45 lectures.

Number of hours
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Person(s) in charge
LIOT Olivier
olivier.liot@enseeiht.fr

Teaching method
En présence

Teaching language
English

· Teaching Unit Transformation de l'Energie

· Subject HYDI : Hydraulique diphasique

· Subject CHPH : Ecoulements diphasiques avec changements de phase

· Subject THERM : Thermodynamique des turbines à vapeur

· Subject MICRO : Microprocédés et Microéchangeurs

· Teaching Unit Milieux Hétérogènes et Fluides Complexes

· Subject CORA : Coalescence Rupture Agrégation

· Subject RHEO : Rhéologie des fluides complexes

· Subject AGIT : Agitation-Mélange

· Subject PhyCoSep : "PhysicoChemical hydrodynamics"

· Teaching Unit Modélisation numérique (Parcours B)

· Subject MTSS : Modèles de turbulence pour les simul. num. stationn.

· Subject CODC : Simulation des écoulements industriels

· Subject Introduction à LEDAFLOW

· Teaching Unit Formation générale

· Subject Anglais 3HY et M2 DET semestre 9

Pre-requisites

None.

Objectives

Develop key professional and intercultural communication skills in English.

Targeted skills

1) Write an extended scientific or technical abstract in English.

2) Write a scientific or technical report in English.

3) Present a scientific or technical project in English.

Description

A semester of 12 weekly sessions to develop English intercultural communication competencies for professional purposes.

Number of hours
21 hours

Teaching method
En présence

Teaching language
English

Bibliography

* Gallo, C. (2014). *Talk like TED: the 9 public-speaking secrets of the world's top minds*. St. Martin's Press.
* Meyers, A. (2013). *Longman Academic Writing Series 5: Essays to Research Papers.* Pearson Education.

· Subject Développement Durable, RSE, Ethique

· Subject Gestion et management de projet

· Subject Entreprenariat

· Subject Conférences et soutenance de stage

· Parcours Modélisation et Simulation Numérique (DET)

· Teaching Unit Modélisation

· Subject Modèles pour les interfaces

· Subject Modélisation en turbulence

· Subject Optimisation methods

Objectives

The objective of this course is to get used to classical optimization methods through their numerical implementation on simple examples.

Description

* Data assimilation
* Uncertainty quantification
* Optimisation algorithms
* Deep learning

Person(s) in charge

THUAL Olivier
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Phone 2945

Bibliography

[1] O. Thual, Introduction to Data Assimilation for Scientists and Engineers, Open Learn. Res. Ed. INPT, 0202 (2013) 6h

[2] O. Thual, S. Gratton, G. Monnier, O. Pannekoucke et al, Data Assimilation for Scientists and Engineers, a Toulouse University pedagogical project, Pedago'Tech Toulouse INP (2013)

· Teaching Unit Applications à l'aero.

· Subject Aérodynamique

Pre-requisites

"Basics" in Fluid Mechanics

"Basics" in Thermodynamics

Objectives

Introduce the main physical concepts and mathematical tools to adress both incompressible and compressible aerodynamics problems. By the end of this class, students will be able to model the flow around an airfoil and a wing, to evaluate the forces applied to a wing and to evaluate its global performance. They will also be aware of advantages and drawbacks of such theoretical models.

Description

- General introduction, terminology and nomenclature.

- How does an airplane generate lift?

- Linearized thin airfoil theory (2D) and effects of hypersustentation devices in incompressible subsonic flow.

- Direct problem (knowing the geometry of the profile, how to calculate the aerodynamic coefficients) and inverse problem (knowing the performance objectives in terms of aerodynamic coefficients, how to calculate the geometry of the profile).

-The lifting-line theory for the wings (3D) and the effect of the wing shape, aspect ratio and twist.

- Linearized theory (Prandtl-Glauert) around a profile (2D) for the compressible subsonic regime.

-The transonic regime.

- Linearized theory (Ackeret) around a profile (2D) for the supersonic regime.

- Recalls on the resolution of shocks / relaxations in the non-linear case.

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Teaching method
En présence

Teaching language
French

Bibliography

Polycopié

J.D.Anderson, Fundamentals of aerodynamics

A.giovanni et C.Airiau, Aérodynamique fondamentale

· Subject Aéroacoustique

· Subject Interactions Fluide-Structure

· Subject Modélisation des transferts proche paroi

· Teaching Unit Méthodes Numériques et Calcul à Haute Performance

· Subject Méth. num. pour simulation des écoulements incompressibles

· Subject Méth. Num. pour la simulation des Ecoulements Compressibles

· Subject Environnement Logiciel du Calcul Scientifique

· Subject Techniques de génération maillage, pré/post processing

· Teaching Unit Projets de Modélisation et Simulation Numérique

· Subject BES schémas compressibles

· Subject BES schémas incompressibles

· Subject BES langages avancés (C++, Python)

· Subject BES nouveaux codes et codes industriels

· Teaching Unit Formation générale

· Subject Anglais 3HY et M2 DET semestre 9

Pre-requisites

None.

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En présence

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· Subject Développement Durable, RSE, Ethique

· Subject Gestion et management de projet

· Subject Entreprenariat

· Subject Conférences et soutenance de stage

· Parcours Sciences de l'Eau et de l'Environnement (DET)

· Teaching Unit Ecoulements environnementaux

Pre-requisites

- Fluid mechanics

- Free-surface flows

Objectives

- know the physical processes involved in fluids flows encountered in the atmosphere, rivers and oceans.

- use advanced and dedicated numerical tools to simulate free-surface flows with sediment/pollutant transport.

· Subject CLAT : Atmospheric boundary layer

Objectives

* Become familiar with the basic concepts of writing and modeling the atmospheric boundary layer.
* To be able to identify the essential elements from the reading of scientific documents in a perspective of practical applications.
* Master the basic analytical developments allowing a physical understanding of the studied phenomena.
* Appropriate the subject by the realization of projects.

Description

Educational principles:

* Self-learning from a body of resources
* Realization of a project with homework and BE
* Link between knowledge and business applications

Three axes of reading:

* Limit layer in the neutral case: Ekmann spiral, logarithmic law
* Waves and thermal instabilities: waves of relief, convection
* Modeling of turbulence: TKE closures, Monin-Obukov

Pedagogy by project:

* A document synthesis from two articles
* A calculation code to develop with results production
* A written report combining knowledge and application case

Person(s) in charge
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Phone 2945

Bibliography

[1] R. Stull, An Introduction to Boundary Layer Meteorology, Atmospheric and Oceanographic Sciences Library, Springer 1988.

[2] R. E. Britter and S. R. Hanna, Flow and dispersion in urban areas, Annu. Rev. Fluid Mech. (2003) 35 :46996

[3] J. Finnigan, Turbulence in plant canopies, Annu. Rev. Fluid Mech. (2000) 32 :51957

· Subject HCLO : Hydrodynamique littorale et côtière

· Subject MODE : Codes de calcul en environnement

Objectives

Use advanced numerical tools for solving problem involving free-surface flows, sediment transport, pollutant transport, waves, atmospherical flows

· Subject MAESL : Modélisation avancée des écoulements à surface libre

Objectives

Use advanced numérical tools to solve 1D-2D free-surface flows problems including sediment/pollutant transport

· Teaching Unit Hydrologie

Objectives

- Get advanced knowledge in hydrology (surface and subsurface flows) and in urban hydraulics

- Use specific numerical tools for solving such problems

· Subject Modélisation Hydrologie Approfondie

Pre-requisites

Hydrological balance or equivalent

Objectives

Qualitative et quantitative description of the water cycle processes

Knowledge of available models for each of these processes

Ability to propose and establish adequate model

Be aware of models limitations

Keep in touch with research advances

Targeted skills

Be able to implement hydrological modelling on a study site according to a given objective

Description

Down to basics: why models?

Processes involved in the hydrologic cycle (Interception and snow melt, Evapotranspiration, Infiltration, Surface flow, ...): description and common models

Some examples of rainfall-runoff models

Calibration/Validation : procedure and potential pitfalls

Modelling dedicated to flood prediction

Person(s) in charge
ROUX Helene
Helene.Roux@imft.fr
Phone 2840

CASSAN Ludovic
Ludovic.Cassan@imft.fr
Phone 2971

Teaching method
En présence

Teaching language
French, slides in english

Bibliography

Anctil, F., Rousselle, J. and Lauzon, N., 2005. Hydrologie - Cheminements de l'eau. Presses Internationales Polytechnique, 318 pp.

Maidment, D.R. (Editor), 1993. Handbook of hydrology. McGraw-Hill.

Roche, P.-A., Miquel, J. and Gaume, E., 2012. Hydrologie quantitative - Processus, modèles et aide à la décision. Springer. 590 pp.

· Subject HSOUT : Hydrologie souterraine

· Subject EURB : L'eau en milieu urbain

Objectives

The design methods of sewage systems have undergone many changes. The course objective is to understand how water is integrated into the city and its urbanization and to integrate the stakes of the development of a sewage network in dry weather or rainy weather.

Description

This courses deals with the following points:

- General presentation

- Origins, Challenges, Perspectives

- Design of a sewage network

  * Rainy water

  * Waste water

- Alternative Techniques

  - Detention pools

- Sizing method

  * Caquot method

  * Dynamic method

- Study on modeling in urban hydrology

· Teaching Unit Aménagement et Ouvrages

Objectives

Get essential knowledge regarding hydraulic equipments (dams, dikes, etc) and hydro-electricity, from the technical and environmental point of view

· Subject MSOL : Mécanique des sols

· Subject INGO : Ingénierie des ouvrages hydrauliques

· Subject RISP : Risque et prévention

· Subject Système d'information géographique

· Subject IMPA : Impact des aménagements industriels sur l'env.

· Teaching Unit Transport

Objectives

Know the physical processes involved in the transport and mixing of sediments or pollutant in rivers, reservoirs and oceans

· Subject TREM : Transport et mélange

· Subject TSMO : Transport sédimentaire et morphodynamique

Pre-requisites

Fluid mechanics

Objectives

Introduction to the physical processes involved in sediment transport by a fluid and the estimation of the mass fluxes and bed evolution resulting from sediment transport.

Description

I. Géomorpholoqy of coasts and rivers

II. Local processes and morphodynamics

III. Sediment properties

IV. Incipient motion

V. Modeling bedload transport

VI. Modeling suspended load transport

VII. Numerical approaches for modeling sediment transport

Bibliography

-Principles of Sediment Transport in Rivers, Estuaries and Coastal Seas, LC. Van Rijn 1990 Aqua Publications.

- Hydraulics of sediment transport, W.H. Graf 1984 Water Ressources Publications

· Subject HSTA : Hydrologie statistique

· Subject HTRA : Hydrologie des transferts

· Teaching Unit Formation générale

· Subject Anglais 3HY et M2 DET semestre 9

Pre-requisites

None.

Objectives

Develop key professional and intercultural communication skills in English.

Targeted skills

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· Subject Gestion et management de projet

· Subject Entreprenariat

· Subject Conférences et soutenance de stage

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- Use specific numerical tools for solving such problems

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Teaching method
En présence

Teaching language
French, slides in english

Bibliography

Anctil, F., Rousselle, J. and Lauzon, N., 2005. Hydrologie - Cheminements de l'eau. Presses Internationales Polytechnique, 318 pp.

Maidment, D.R. (Editor), 1993. Handbook of hydrology. McGraw-Hill.

Roche, P.-A., Miquel, J. and Gaume, E., 2012. Hydrologie quantitative - Processus, modèles et aide à la décision. Springer. 590 pp.

· Subject HSOUT : Hydrologie souterraine

· Subject EURB : L'eau en milieu urbain

Objectives

The design methods of sewage systems have undergone many changes. The course objective is to understand how water is integrated into the city and its urbanization and to integrate the stakes of the development of a sewage network in dry weather or rainy weather.

Description

This courses deals with the following points:

- General presentation

- Origins, Challenges, Perspectives

- Design of a sewage network

  * Rainy water

  * Waste water

- Alternative Techniques

  - Detention pools

- Sizing method

  * Caquot method

  * Dynamic method

- Study on modeling in urban hydrology

· Teaching Unit UE Sciences Humaines (M2 DET)

· Subject Anglais 3HY et M2 DET semestre 9

Pre-requisites

None.

Objectives

Develop key professional and intercultural communication skills in English.

Targeted skills

1) Write an extended scientific or technical abstract in English.

2) Write a scientific or technical report in English.

3) Present a scientific or technical project in English.

Description

A semester of 12 weekly sessions to develop English intercultural communication competencies for professional purposes.

Number of hours
21 hours

Teaching method
En présence

Teaching language
English

Bibliography

* Gallo, C. (2014). *Talk like TED: the 9 public-speaking secrets of the world's top minds*. St. Martin's Press.
* Meyers, A. (2013). *Longman Academic Writing Series 5: Essays to Research Papers.* Pearson Education.

· Subject Droit, sociologie, économie de l'environnement

· Subject Système de Management environnemental

· Teaching Unit UE Ingénierie et traitement des eaux

· Subject Procédé de dépollution

· Subject Valorisation des déchets

· Subject Traitement des eaux

· Teaching Unit Harmonisation

· Teaching Unit Milieux naturels

· Teaching Unit B.E.I.

· Teaching Unit GE-Modules Opt°-M1DET

· Tronc commun 1

Choice: 1 Among 1 :

· Teaching Unit UE 11 TRonc commun 1

· Subject Combustion : théorie et modélisation

· Subject Ecoulements diphasiques et Changement de phase

· Teaching Unit UE 12 TRonc commun 1

· Subject Dynamique des Fluides en Milieux Ppreux

· Subject Aérosols et suspension

· Tronc commun 2

Choice: 1 Among 1 :

· Teaching Unit UE 21 TRonc commun 2

· Subject Instabalitiés Hydrodynamiques

· Subject Aéroacoustique

· Teaching Unit UE 22 TRonc commun 2

· Subject Dynamique des écoulements incompressibles

· Subject Physique du rayonnement

· M2 DET Semestre 10

· Semestre 10 HY PL + PFE

· Teaching Unit PFE standard HMF

· Teaching Unit Projet Long HMF

· Teaching Unit VALORISATION SCIENTIFIQUE PFE

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications