SCIENCES, INGÉNIERIE ET TECHNOLOGIES

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique

Target level
BAC +5

Subprograms

- Ingénieur ENSEEIHT Mécanique et Génie Hydraulique (Étudiants)
- Ingénieur ENSEEIHT Mécanique et Génie Hydraulique (Apprentis)

Presentation

Program

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique (Étudiants)

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique 1ère année

Semestre 5-1A Méca-GH-FISE

	Nature	CM	TD	TP	Crédits
Soft and Human Skills	UE				5 credits
Anglais	Matière				
Second language	Choix				
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S5	Matière				
Sports	Matière				
Leadership and management	Matière				
Mathematics 1	UE				5 credits
Integration	Matière				
Probabilities	Matière				
Computer science 1 - Basics of algorithms, programming and computer architecture	UE				5 credits
Applied Informatics: Systems, Tools, Architectures	Matière				
Analysis and Programming method : Algorithmics	Matière				
Fluid Mechanics 1	UE				5 credits
Introduction to Fluid Mechanics	Matière				
Continuum mechanics	Matière				
Pratique Expérimentale en Mécanique des Fluides	Matière				
Fluid Mechanics 2	UE				5 credits
Thermodynamics	Matière				
Mechanics 1	UE				5 credits
Linear Elasticity	Matière				

Semestre 6-1A MF2E-N7

	Nature	CM	TD	TP	Crédits
SOFT AND HUMAN SKILLS 2	UE				5 credits
Elément à choix UE SHS S6 FISE	Élément constitutif				
English	Matière				
Sports	Matière				
Leadership Part 1 - S6	Matière				
Leadership Part 2 - S6	Matière				
Entrepreneuship Part 1 - S6	Matière				
Entrepreneurship Part 2 - S6	Matière				
Citizenship Part 1 - S6	Matière				
Citizenship Part 2 - S6	Matière				
Agile methods	Matière				
Managership P1-S6	Matière				
Managership P2-S6	Matière				
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
FSL - S6	Matière				
Mathematics 2	UE				5 credits
Finite Differences	Matière				
Statistics	Matière				
Introduction to optimization	Matière				
Signal Processing & Control systems	UE				5 credits
Signal and Automatic	Matière				
Fluid Mechanics 3	UE				5 credits
Flow at large Reynolds	Matière				
Low Reynolds Flows	Matière				
Bubbles, Drops and Particles	Matière				
Hydraulic Engineering	UE				5 credits
Numerical Methods - Finished Volumes	Matière				
Numerical Laminar Simulations - FLUENT Software	Matière				
Hydraulic Engineering	UE				5 credits
Integral Balances	Matière				
Hydraulics : Learning By Project	Matière				

Semestre 6-N7-1A Mécanique-GH FISE

	Nature	CM	TD	TP	Crédits

SOFT AND HUMAN SKILLS 2	UE	5 credits
Elément à choix UE SHS S6 FISE	Élément constitutif	
English	Matière	
Sports	Matière	
Leadership Part 1 - S6	Matière	
Leadership Part 2 - S6	Matière	
Entrepreneuship Part 1 - S6	Matière	
Entrepreneurship Part 2 - S6	Matière	
Citizenship Part 1 - S6	Matière	
Citizenship Part 2 - S6	Matière	
Agile methods	Matière	
Managership P1-S6	Matière	
Managership P2-S6	Matière	
Spanish	Matière	
Portuguese	Matière	
Chinese	Matière	
Italian	Matière	
Japonese	Matière	
Russian	Matière	
German	Matière	
French as a Foreign Language	Matière	
FSL - S6	Matière	
ELP à Choix	Choix	
Hydraulic Engineering	UE	5 credits
Integral Balances	Matière	
Hydraulics : Learning By Project	Matière	
Discovery in fluid mechanices	UE	5 credits
Introduction to flying	Matière	
Renewable energies	Matière	
Mathematics 2	UE	5 credits
Finite Differences	Matière	
Statistics	Matière	
Introduction to optimization	Matière	
Signal Processing & Control systems	UE	5 credits
Signal and Automatic	Matière	
Fluid Mechanics 3	UE	5 credits
Flow at large Reynolds	Matière	
Low Reynolds Flows	Matière	
Bubbles, Drops and Particles	Matière	
Hydraulic Engineering	UE	5 credits
Numerical Methods - Finished Volumes	Matière	
Numerical Laminar Simulations - FLUENT Software	Matière	

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique 2ème année

Semestre 7 MF2E Parcours N7-2A-Mécanique-GH FISE

	Nature	CM	TD	TP	Crédits
SOFT AND HUMAN SKILLS	UE				5 credits
Professional English 2.1 : Presentations	Matière				
2nd language	Bloc				
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S7	Matière				
Sports	Matière				
Leadership & Management	Matière				
FLUID MECHANICS 4	UE				5 credits
Complex Fluids	Matière				
Boundary Layers, Jet and laminar wakes	Matière				
FLUID MECHANICS 5	UE				5 credits
Turbulent Flows Introduction	Matière				
History of Fluid Mechanics	Matière				
SCIENTIFIC COMPUTING 2	UE				5 credits
Advanced use of CFD codes	Matière				
Numerical Methods for PDE	Matière				
Stochastic Processes	Matière				
TRANSFERTS	UE				5 credits
Heat and Mass Exchange	Matière				
Transfers in porous media	Matière				
MECHANICS 2	UE				5 credits
Wave dynamics	Matière				
Introduction to structure mechanics	Matière				

Semestre 8 MF2E FISE

	Nature	CM	TD	TP	Crédits
Parcours Eau et Environement S8	Choix				30 credits
SOFT AND HUMAN SKILLS	UE				5 credits
Professional English 2.2 : Debates	Matière				
Second language	Choix				

Spanish	Matière	
Spanish	Matière	
Chinese	Matière	
Italian	Matière	
Japanese	Matière	
Russian	Matière	
German	Matière	
french (as a foreign language)	Matière	
LSF - S8	Matière	
Sports	Matière	
Careers and Management - Sem.8	Choix	
Leadership	Matière	
Entrepreneurship	Matière	
Citizenship	Matière	
Managership-S8	Matière	
Choice of UE PROJECT MF2E S8	Choix	
Experimental Project	UE	5 credits
Experimental Project	Matière	
Numerical Project	UE	5 credits
Numerical Project	Matière	
Research project	UE	5 credits
Research project	Matière	
HYDRODYNAMICS AND STRUCTURES	UE	5 credits
Open channel flows	Matière	
TRANSFER IN POROUS MEDIA	UE	5 credits
Erosion and Solids Transport	Matière	
Eco-hydraulic	Matière	
CLIMATE PROJECT BASED LEARNING	UE	5 credits
Climate PBL	Matière	
Parcours Fluides et Procédés S8	Choix	30 credits
SOFT AND HUMAN SKILLS	UE	5 credits
Professional English 2.2 : Debates	Matière	
Second language	Choix	
Spanish	Matière	
Spanish	Matière	
Chinese	Matière	
Italian	Matière	
Japanese	Matière	
Russian	Matière	
German	Matière	
french (as a foreign language)	Matière	
LSF - S8	Matière	
Sports	Matière	
Careers and Management - Sem.8	Choix	
Leadership	Matière	
Entrepreneurship	Matière	

Citizenship	Matière				
Managership-S8	Matière				
Choice of UE PROJECT MF2E S8	Choix				
Experimental Project	UE				5 credits
Experimental Project	Matière				
Numerical Project	UE				5 credits
Numerical Project	Matière				
Research project	UE				5 credits
Research project	Matière				
AERODYNAMICS	UE				5 credits
Compressible Flows	Matière				
Gas turbomachines	Matière				
INDUSTRIAL SYSTEMS	UE				5 credits
Physical Analysis of Industrial Processes	Matière				
Thermodynamics of Machines	Matière				
Simulation Hydrodynamique et Transferts	Matière				
MULTI-SCALE PROCESSES	UE				5 credits
Vibration under flow	Matière				
Microfluidic Introduction	Matière				
TEDT : Turbulent Dispersion	Matière				

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique 3ème année

Semestre 9 MF2E FISE

	Nature	CM	TD	TP	Crédits
Science de l'Eau et Environnement (SEE)	Parcours				30 credits
Soft and Human Skills MF2E S9	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				
Choix de Spécialité-SEE	Choix				
Spécialité-SEE	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				

Transport and Mixing	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
Spécialité-SEE-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
Spécialité-SEE-BD	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Spécialité-SEE-Aéro-BD	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Modélisation et Simulation Numérique (MSN)	Parcours	30 credits
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	

Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix de Spécialité-MSN	Choix	
Spécialité-MSN	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
Spécialité-MSN-Env	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
Spécialité-MSN-Enr	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
Spécialité-MSN-Env-BD	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	

MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits
Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
Fluide et Procédés (FEP)	**Parcours**	**30 credits**
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix Harmonisation	Choix	
HARMONISATION A7	UE	
Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
Choix de Spécialité-FEP	Choix	
Spécialité-FEP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	

ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	

NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-FEIP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
Spécialité-FEP-FEIP-Comb	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Éco-Énergie (EE)	Parcours	30 credits

SYSTEMIC DESIGN	UE	5 credits
System modeling in Bond Graph	Matière	
Eco-design and LCA	Matière	
Hydrogen supply chain	Matière	
Optimization of energy processes and systems	Matière	
SMART-GRIDS	UE	5 credits
Decentralized, embedded electrical networks	Matière	
Energy Hybridization of Systems	Matière	
Smart grids	Matière	
RENEWABLE ENERGIES	UE	5 credits
Wind Power Systems	Matière	
Photovoltaic APP	Matière	
Low-Power Hydroelectric Installations	Matière	
GENERAL TRAINING	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
Themed Day: Energy and Sustainable Development	Matière	
Impact Entrepreneurship from Low to Deep Tech MF2E	**Parcours**	**30 credits**
Choix UE Hard Skills MF2E Parcours Impact Entrepreneurship	Bloc	
Choix UE Parc. MSN Parc. Impact Entrepreneurship	Choix	
MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits
Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	

TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Choix UE Parc. SEE Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Choix UE Parc. FEP Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
HARMONISATION A7	UE	

Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
SOFT SKILLS 1 - PARTNERSHIPS	UE	5 credits
UT ou TBS ou TSM 1 - module 18h	Matière	
UT ou TBS ou TSM 2 - module 18h	Matière	
UT ou TBS ou TSM 3 - module 18h	Matière	
SOFT SKILLS 2 - DESIGN THINKING	UE	5 credits
Design Thinking 1 - module 15h	Matière	
Design Thinking 2 - module 18h	Matière	
Professional Communication and English - module 21h	Matière	
SOFT SKILLS 3 - PROJET DEEP TECH & APPLICATIONS	UE	5 credits
PDT & CU 1 - module 18h	Matière	
PDT & CU 2 - module 18h	Matière	
PDT & CU 3 - module 18h	Matière	
Génie de l'Environnement (GE)	Parcours	30 credits
GE - Harmonisation	UE	2 credits
GE - Chimie des solutions	Élément constitutif	

GE - Hydraulique - Introduction à l'hydrologie	Élément constitutif				
GE - Agro-écosystèmes	Élément constitutif				
GE - SIG	Élément constitutif				
GE - Gestion de l'eau	UE				5 credits
GE - Gestion des déchets	UE				5 credits
GE - Industries et milieux naturels	UE				5 credits
GE - Economie circulaire	UE				5 credits
GE - Projet long	UE				4 credits
GE - Approfondissement	Bloc				4 credits
GE - Impacts Anthropiques	UE				4 credits
GE - Ingenierie de l'aménagement	UE				4 credits
GE - Ingenierie du développement soutenable	UE				4 credits

Semestre 10 à l'N7-3A-MF2E

	Nature	CM	TD	TP	Crédits
PFE FISA	UE				30 credits
PROJET FIN D'ETUDES MF2E SANS PROJET LONG	UE				30 credits
Stage 2A MF2E	Matière				6 credits
PFE MF2E sans PL	Module				24 credits
PFE MF2E avec PL	UE				
PROJET LONG MF2E	Matière				8 credits
PROJET DE FIN D'ETUDE-MF2E	Matière				16 credits
Stage 2A MF2E	Matière				6 credits

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique (Apprentis)

Ingénieur ENSEEIHT par l'apprentissage Mécanique et Génie Hydraulique 1ère Année

Semestre 5-1A Mécanique-GH FISA

	Nature	CM	TD	TP	Crédits
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S5-FISA	UE				4 credits
Careers and Management 1	Matière				
Careers and Management 2	Matière				
Anglais Professionnel-S5-App	Matière				
MATHEMATIQUES ET CALCUL SCIENTIFIQUE 1	UE				4 credits
Mathematics 1	Matière				
Scinetific calculation and Programming 1	Matière				

MECANIQUES DES MILIEUX CONTINUS	UE	4 credits
Mécanique des Milieux Continus	Matière	
THERMODYNAMIQUE	UE	4 credits
Thermodynamics	Matière	
SIGNAUX ET SYSTEMES	UE	4 credits
Systems and Signals	Matière	
FORMATION ENTREPRISE-S5 (App.)	UE	10 credits

Semestre 6-1A Mécanique-GH FISA

	Nature	CM	TD	TP	Crédits
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S6-FISA	UE				4 credits
Anglais Professionnel-S6-FISA	Matière				
Careers and Management 1	Matière				
Careers and Management 2	Matière				
MATHEMATIQUES ET CALCUL SCIENTIFIQUE 2	UE				4 credits
Mathematics 2	Matière				
Scientific calculation and programming 2	Matière				
MECANIQUE DES FLUIDES 1	UE				4 credits
Mécanique des Fluides 1	Matière				
THERMIQUE 1	UE				4 credits
Thermique 1	Matière				
HYDRAULIQUE	UE				4 credits
Hydraulique	Matière				
FORMATION ENTREPRISE - S6 (App.)	UE				10 credits

Ingénieur ENSEEIHT par l'Apprentissage Mécanique et Génie Hydraulique 2ème année

Semestre 7-2A-Mécanique-GH FISA

	Nature	CM	TD	TP	Crédits
MECANIQUE DES FLUIDES 2	UE				4 credits
Boundary layer	Matière				
Compressible	Matière				
SYSTEMES ET FLUIDES COMPLEXES	UE				4 credits
Systems and Complex Fluids	Matière				
THERMIQUE 2	UE				4 credits
Thermique 2	Matière				
MECANIQUES DES FLUIDES 3	UE				4 credits
Mécanique des Fluides 3	Matière				

FORMATION ENTREPRISE-S7 (App.)	UE				10 credits
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S7-FISA	UE				4 credits
Anglais Professionnel-S7-App	Matière				
Careers and Management 1- App Sem7	Matière				
Careers and Management 2- APP Sem7	Matière				

Semestre 8-2A App. Mécanique et GH (MF2E)

	Nature	CM	TD	TP	Crédits
MECANIQUE ET MACHINES	UE				4 credits
Mécanique des Solides et Structures - S8	Matière				
Machine Thermodynamics	Matière				
TRANSFERTS EN MILIEUX NATURELS	UE				4 credits
Tranfert en Milieux Naturels	Matière				
PROJET	UE				4 credits
Projet Industriel	Matière				
Projet Ecole	Matière				
ELASTICITE-PLASTICITE	UE				4 credits
Elasticity Plasticity	Matière				
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S8-FISA	UE				4 credits
Anglais Professionnel-S8-App	Matière				
Careers and Management 1	Matière				
Careers and Management 2	Matière				

Ingénieur ENSEEIHT par l'Apprentissage Mécanique et Génie Hydraulique 3ème année

Semestre 9 MF2E FISA

	Nature	CM	TD	TP	Crédits
Science de l'Eau et Environnement (SEE)	Parcours				30 credits
Soft and Human Skills MF2E S9	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				

Corporate Project and social responsability	Matière	
Choix de Spécialité-SEE	Choix	
Spécialité-SEE	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
Spécialité-SEE-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
Spécialité-SEE-BD	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Spécialité-SEE-Aéro-BD	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	

TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Modélisation et Simulation Numérique (MSN)	Parcours	30 credits
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix de Spécialité-MSN	Choix	
Spécialité-MSN	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
Spécialité-MSN-Env	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
Spécialité-MSN-Enr	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
Spécialité-MSN-Env-BD	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits

Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits
Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
Fluide et Procédés (FEP)	**Parcours**	**30 credits**
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix Harmonisation	Choix	
HARMONISATION A7	UE	
Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
Choix de Spécialité-FEP	Choix	
Spécialité-FEP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits

Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	

Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-FEIP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
Spécialité-FEP-FEIP-Comb	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	

REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Éco-Énergie (EE)	Parcours	30 credits
SYSTEMIC DESIGN	UE	5 credits
System modeling in Bond Graph	Matière	
Eco-design and LCA	Matière	
Hydrogen supply chain	Matière	
Optimization of energy processes and systems	Matière	
SMART-GRIDS	UE	5 credits
Decentralized, embedded electrical networks	Matière	
Energy Hybridization of Systems	Matière	
Smart grids	Matière	
RENEWABLE ENERGIES	UE	5 credits
Wind Power Systems	Matière	
Photovoltaic APP	Matière	
Low-Power Hydroelectric Installations	Matière	
GENERAL TRAINING	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
Themed Day: Energy and Sustainable Development	Matière	
Impact Entrepreneurship from Low to Deep Tech MF2E	Parcours	30 credits
Choix UE Hard Skills MF2E Parcours Impact Entrepreneurship	Bloc	
Choix UE Parc. MSN Parc. Impact Entrepreneurship	Choix	
MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits

Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Choix UE Parc. SEE Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Choix UE Parc. FEP Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	

TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
HARMONISATION A7	UE	
Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
SOFT SKILLS 1 - PARTNERSHIPS	UE	5 credits
UT ou TBS ou TSM 1 - module 18h	Matière	
UT ou TBS ou TSM 2 - module 18h	Matière	
UT ou TBS ou TSM 3 - module 18h	Matière	
SOFT SKILLS 2 - DESIGN THINKING	UE	5 credits
Design Thinking 1 - module 15h	Matière	
Design Thinking 2 - module 18h	Matière	
Professional Communication and English - module 21h	Matière	
SOFT SKILLS 3 - PROJET DEEP TECH & APPLICATIONS	UE	5 credits

PDT & CU 1 - module 18h	Matière	
PDT & CU 2 - module 18h	Matière	
PDT & CU 3 - module 18h	Matière	
Génie de l'Environnement (GE)	Parcours	30 credits
GE - Harmonisation	UE	2 credits
GE - Chimie des solutions	Élément constitutif	
GE - Hydraulique - Introduction à l'hydrologie	Élément constitutif	
GE - Agro-écosystèmes	Élément constitutif	
GE - SIG	Élément constitutif	
GE - Gestion de l'eau	UE	5 credits
GE - Gestion des déchets	UE	5 credits
GE - Industries et milieux naturels	UE	5 credits
GE - Economie circulaire	UE	5 credits
GE - Projet long	UE	4 credits
GE - Approfondissement	Bloc	4 credits
GE - Impacts Anthropiques	UE	4 credits
GE - Ingenierie de l'aménagement	UE	4 credits
GE - Ingenierie du développement soutenable	UE	4 credits

Semestre 10 à l'N7-3A-MF2E

	Nature	CM	TD	TP	Crédits
PFE FISA	UE				30 credits
PROJET FIN D'ETUDES MF2E SANS PROJET LONG	UE				30 credits
Stage 2A MF2E	Matière				6 credits
PFE MF2E sans PL	Module				24 credits
PFE MF2E avec PL	UE				
PROJET LONG MF2E	Matière				8 credits
PROJET DE FIN D'ETUDE-MF2E	Matière				16 credits
Stage 2A MF2E	Matière				6 credits

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique (Apprentis)

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique

ECTS
180 credits

Duration
3 ans

Teaching organization
Formation en alternance, Formation initiale

Presentation

Le candidat recruté obtient le double statut d'élève ingénieur et de salarié apprenti au sein d'une entreprise. L'élève signe un contrat d'apprentissage et s'engage à travailler dans son entreprise d'accueil pour une durée de 3 ans, contre rémunération.
La formation est répartie sur 6 semestres sur 3 ans, alternant semaines de cours et semaines en entreprise. La formation se compose de cours théoriques, travaux dirigés, travaux pratiques et projets dans les différentes matières. Durant les périodes académiques et les périodes en entreprise, la formation est structurée en Unités d'Enseignement (UE) auxquelles sont associés des crédits ECTS. La validation d'une année est conditionnée par l'obtention de 60 crédits ECTS dont des crédits obtenus en entreprise.
Pour l'obtention du diplôme, les élèves devront :
-obtenir 300 crédits ECTS ;
- justifier un niveau d'anglais certifié équivalent au niveau européen B2
-justifier de 12 semaines de mobilité internationale ou de travail en contexte international.
L'obtention d'un diplôme d'ingénieur ENSEEIHT, quelle que soit la discipline, implique les qualités suivantes :
- Maitrise des méthodes et outils de l'ingénieur et d'un large champ disciplinaire.
- Capacité à concevoir, réaliser et valider des solutions, des méthodes,des produits, des systèmes et des services.
- Aptitude à innover, entreprendre, collecter et intégrer des savoirs et à mener des projets de recherche.
- Maitrise des enjeux de l'entreprise relatifs à son fonctionnement dans ses dimensions économique, juridique, environnementale et sociétale.
- Aptitude à s'intégrer et à travailler au sein d'une organisation multiculturelle et internationale.
- Savoir gérer sa formation et sa carrière professionnelle.
L'ingénieur INP-ENSEEIHT "Mécanique et Génie Hydraulique" est un ingénieur de haut niveau technique et scientifique par la formation qu'il a suivie dans les domaines de la mécanique des fluides, de la combustion, de l'hydrologie, incluant la modélisation numérique et le calcul intensif.
Grace au socle commun de formation, l'ingénieur INP-ENSSEEIHT "Mécanique et Génie Hydraulique" :
- Maitrise les concepts et principes de la mécanique des fluides.
- Maitrise les systèmes thermodynamiques et les mécanismes de transferts.
- Maitrise les principes de base de la mécanique des solides et des structures.
- Maitrise les systèmes à fluides.
- Maitrise les méthodes numériques et le calcul scientifique haute performance.
- Maitrise les techniques d'instrumentation et de mesure utilisées en mécanique et mécanique des fluides.
- Conçoit, dimensionne et modélise des systèmes pour l'énergie, le transport et les procédés.
- Conçoit, dimensionne et modélise des systèmes liés à des problématiques environnementales, naturelles et climatiques.

- Identifie, développe et valide des algorithmes pour la simulation numérique haute performance en mécanique des fluides.
- Conçoit, développe et caractérise des systèmes de contrôle pour la régulation et la commande de dispositifs hydrauliques et énergétiques, et pour le développement des systèmes nomades et embarqués.
- Modélise des problèmes de mécanique multi-échelles et/ou multi-physiques et/ou stochastiques.

Compétences détaillées :

-Identifier les régimes d'écoulements afin de proposer une modélisation adaptée d'un problème mettant en jeu des écoulements en mécanique des fluides générale et/ou en aérodynamique

-Appréhender les modèles physiques, la représentation des écoulements à tout régime pour optimiser des systèmes mécaniques complexes en mobilisant de manière croisée les concepts de l'aérodynamique, de la physique et du calcul numérique

-Identifier, sélectionner et analyser avec esprit critique des données issues d'expérimentations in situ ou de laboratoire ou de simulations numériques afin de représenter un phénomène multi-physique ou physique environnemental

-Conduire des projets en respectant les contraintes du cahier des charges, en utilisant des outils appropriés, dans un cadre collaboratif et communiquer les résultats en s'adaptant au public visé

-Analyser et modéliser les écoulements atmosphériques à toute échelle en réponse à une problématique environnementale

-Appréhender la modélisation, la représentation des écoulements à surface libre et souterrains afin de prévoir des aménagements ou de répondre à des enjeux sociétaux

-Mobiliser les concepts fondamentaux de la mécanique dans un but de conception, de dimensionnement et de maintenance d'ouvrages

-Analyser, contrôler et modéliser le fonctionnement des ouvrages hydrauliques afin de les gérer dans le respect des contraintes réglementaires et environnementales

-Choisir et mettre en oeuvre des modèles permettant d'appréhender des situations naturelles complexes dans un monde en transition

-Expliquer les phénomènes multiphysiques mis en jeu dans un système complexe et multi-échelle en mobilisant les concepts fondamentaux de l'énergétique

-Choisir et mettre en oeuvre des modèles afin de simuler le fonctionnement de systèmes énergétiques et multiphasiques afin de les caractériser et de les optimiser

-Identifier, sélectionner, représenter et analyser avec esprit critique des données issues d'expérimentations in situ ou de laboratoire ou de simulations numériques afin de représenter un phénomène physique en énergétique

-Mobiliser les concepts fondamentaux du calcul scientifique pour mettre en équation des phénomènes physiques en mécanique des fluides et adapter les méthodes de résolution

-Interpréter les résultats d'une simulation afin de critiquer les modèles pour améliorer et critiquer le système physique et sa représentation

-Utiliser les concepts de l'IA pour développer des modèles évolués permettant de traiter des problèmes physiques plus efficacement

-Développer sa réflexivité, en particulier la connaissance de soi, prototyper sur les principes de design thinking dans un cycle vertueux. Evaluer son bien-être, physique, mental et social, à gérer ses émotions et celles des autres, à être résilient et persévérer pour atteindre des objectifs d'un projet dans un contexte volatile, incertain, complexe, ambigu (VUCA), veiller au bien-être (physique, mental, social) et à l'épanouissement de ses collaborateurs et de soi-même.

-Construire son réseau professionnel via des outils et des techniques de branding personnel et de e-réputation, pour se représenter et représenter la profession d'ingénieur en tant qu'ambassadeur, faire rayonner auprès de publics divers le rôle et la fonction de l'ingénieur.e dans le respect de l'éthique, de la multiculturalité, de la diversité, du développement durable et de la responsabilité sociétale.

-Faire preuve de créativité et d'innovation, d'esprit d'entreprise, d'ouverture d'esprit, de conscience critique, de sens des responsabilités, d'engagement, pour développer des solutions respectueuses des transitions sociales et environnementales.

Admission

Access conditions

Selon les termes de son règlement, fixé chaque année en accord avec le Ministère chargé de l'éducation nationale,

l'ENSEEIHT recrute environ 380 élèves par an sous statut étudiant (dont 70 environ dans la spécialisation Mécanique et Génie Hydraulique), 60 sous statut apprenti dont 20 dans la spécialisation Mécanique et Génie Hydraulique.
Les élèves recrutés sont issus d'un concours sur titres. L'accès est autorisé à des étudiants titulaires d'un DUT (Diplôme Universitaire Technologique) ou d'un BTS (Brevet de Technicien Supérieur).

Program

Organization

L'organisation des études sous statut apprenti (FISA) repose sur le principe de l'alternance école/entreprise. Le volume est d'environ 21 semaines de présence à l'école par année académique, avec un rythme d'alternance différent suivant l'année d'étude.

Ingénieur ENSEEIHT par l'apprentissage Mécanique et Génie Hydraulique 1ère Année

Semestre 5-1A Mécanique-GH FISA

	Nature	CM	TD	TP	Crédits
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S5-FISA	UE				4 credits
Careers and Management 1	Matière				
Careers and Management 2	Matière				
Anglais Professionnel-S5-App	Matière				
MATHEMATIQUES ET CALCUL SCIENTIFIQUE 1	UE				4 credits
Mathematics 1	Matière				
Scinetific calculation and Programming 1	Matière				
MECANIQUES DES MILIEUX CONTINUS	UE				4 credits
Mécanique des Milieux Continus	Matière				
THERMODYNAMIQUE	UE				4 credits
Thermodynamics	Matière				
SIGNAUX ET SYSTEMES	UE				4 credits
Systems and Signals	Matière				
FORMATION ENTREPRISE-S5 (App.)	UE				10 credits

Semestre 6-1A Mécanique-GH FISA

	Nature	CM	TD	TP	Crédits
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S6-FISA	UE				4 credits
Anglais Professionnel-S6-FISA	Matière				
Careers and Management 1	Matière				
Careers and Management 2	Matière				
MATHEMATIQUES ET CALCUL SCIENTIFIQUE 2	UE				4 credits
Mathematics 2	Matière				
Scientific calculation and programming 2	Matière				
MECANIQUE DES FLUIDES 1	UE				4 credits
Mécanique des Fluides 1	Matière				

THERMIQUE 1	UE				4 credits
Thermique 1	Matière				
HYDRAULIQUE	UE				4 credits
Hydraulique	Matière				
FORMATION ENTREPRISE - S6 (App.)	UE				10 credits

Ingénieur ENSEEIHT par l'Apprentissage Mécanique et Génie Hydraulique 2ème année

Semestre 7-2A-Mécanique-GH FISA

	Nature	CM	TD	TP	Crédits
MECANIQUE DES FLUIDES 2	UE				4 credits
Boundary layer	Matière				
Compressible	Matière				
SYSTEMES ET FLUIDES COMPLEXES	UE				4 credits
Systems and Complex Fluids	Matière				
THERMIQUE 2	UE				4 credits
Thermique 2	Matière				
MECANIQUES DES FLUIDES 3	UE				4 credits
Mécanique des Fluides 3	Matière				
FORMATION ENTREPRISE-S7 (App.)	UE				10 credits
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S7-FISA	UE				4 credits
Anglais Professionnel-S7-App	Matière				
Careers and Management 1- App Sem7	Matière				
Careers and Management 2- APP Sem7	Matière				

Semestre 8-2A App. Mécanique et GH (MF2E)

	Nature	CM	TD	TP	Crédits
MECANIQUE ET MACHINES	UE				4 credits
Mécanique des Solides et Structures - S8	Matière				
Machine Thermodynamics	Matière				
TRANSFERTS EN MILIEUX NATURELS	UE				4 credits
Tranfert en Milieux Naturels	Matière				
PROJET	UE				4 credits
Projet Industriel	Matière				
Projet Ecole	Matière				
ELASTICITE-PLASTICITE	UE				4 credits
Elasticity Plasticity	Matière				
SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S8-FISA	UE				4 credits

Anglais Professionnel-S8-App	Matière				
Careers and Management 1	Matière				
Careers and Management 2	Matière				

Ingénieur ENSEEIHT par l'Apprentissage Mécanique et Génie Hydraulique 3ème année

Semestre 9 MF2E FISA

	Nature	CM	TD	TP	Crédits
Science de l'Eau et Environnement (SEE)	Parcours				30 credits
Soft and Human Skills MF2E S9	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				
Choix de Spécialité-SEE	Choix				
Spécialité-SEE	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				
Spécialité-SEE-Aéro	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				
Spécialité-SEE-BD	Bloc				

ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Spécialité-SEE-Aéro-BD	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Modélisation et Simulation Numérique (MSN)	Parcours	30 credits
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix de Spécialité-MSN	Choix	
Spécialité-MSN	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits

Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
Spécialité-MSN-Env	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
Spécialité-MSN-Enr	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
Spécialité-MSN-Env-BD	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits
Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
Fluide et Procédés (FEP)	Parcours	30 credits
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	

Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix Harmonisation	Choix	
HARMONISATION A7	UE	
Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
Choix de Spécialité-FEP	Choix	
Spécialité-FEP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits

PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-FEIP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	

NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
Spécialité-FEP-FEIP-Comb	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Éco-Énergie (EE)	Parcours	30 credits
SYSTEMIC DESIGN	UE	5 credits
System modeling in Bond Graph	Matière	
Eco-design and LCA	Matière	
Hydrogen supply chain	Matière	
Optimization of energy processes and systems	Matière	
SMART-GRIDS	UE	5 credits
Decentralized, embedded electrical networks	Matière	
Energy Hybridization of Systems	Matière	
Smart grids	Matière	
RENEWABLE ENERGIES	UE	5 credits
Wind Power Systems	Matière	
Photovoltaic APP	Matière	
Low-Power Hydroelectric Installations	Matière	
GENERAL TRAINING	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	

Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
Themed Day: Energy and Sustainable Development	Matière	
Impact Entrepreneurship from Low to Deep Tech MF2E	**Parcours**	**30 credits**
Choix UE Hard Skills MF2E Parcours Impact Entrepreneurship	Bloc	
Choix UE Parc. MSN Parc. Impact Entrepreneurship	Choix	
MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits
Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Choix UE Parc. SEE Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits

Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Choix UE Parc. FEP Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
HARMONISATION A7	UE	
Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	

Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
SOFT SKILLS 1 - PARTNERSHIPS	UE	5 credits
UT ou TBS ou TSM 1 - module 18h	Matière	
UT ou TBS ou TSM 2 - module 18h	Matière	
UT ou TBS ou TSM 3 - module 18h	Matière	
SOFT SKILLS 2 - DESIGN THINKING	UE	5 credits
Design Thinking 1 - module 15h	Matière	
Design Thinking 2 - module 18h	Matière	
Professional Communication and English - module 21h	Matière	
SOFT SKILLS 3 - PROJET DEEP TECH & APPLICATIONS	UE	5 credits
PDT & CU 1 - module 18h	Matière	
PDT & CU 2 - module 18h	Matière	
PDT & CU 3 - module 18h	Matière	
Génie de l'Environnement (GE)	Parcours	30 credits
GE - Harmonisation	UE	2 credits
GE - Chimie des solutions	Élément constitutif	
GE - Hydraulique - Introduction à l'hydrologie	Élément constitutif	
GE - Agro-écosystèmes	Élément constitutif	
GE - SIG	Élément constitutif	
GE - Gestion de l'eau	UE	5 credits
GE - Gestion des déchets	UE	5 credits
GE - Industries et milieux naturels	UE	5 credits
GE - Economie circulaire	UE	5 credits
GE - Projet long	UE	4 credits
GE - Approfondissement	Bloc	4 credits
GE - Impacts Anthropiques	UE	4 credits
GE - Ingenierie de l'aménagement	UE	4 credits
GE - Ingenierie du développement soutenable	UE	4 credits

Semestre 10 à l'N7-3A-MF2E

	Nature	CM	TD	TP	Crédits
PFE FISA	UE				30 credits
PROJET FIN D'ETUDES MF2E SANS PROJET LONG	UE				30 credits
Stage 2A MF2E	Matière				6 credits
PFE MF2E sans PL	Module				24 credits
PFE MF2E avec PL	UE				
PROJET LONG MF2E	Matière				8 credits
PROJET DE FIN D'ETUDE-MF2E	Matière				16 credits
Stage 2A MF2E	Matière				6 credits

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique (Étudiants)

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique

ECTS
180 credits

Duration
3 ans

Teaching organization
Formation initiale

Program

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique 1ère année

Semestre 5-1A Méca-GH-FISE

	Nature	CM	TD	TP	Crédits
Soft and Human Skills	UE				5 credits
Anglais	Matière				
Second language	Choix				
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S5	Matière				
Sports	Matière				
Leadership and management	Matière				
Mathematics 1	UE				5 credits
Integration	Matière				
Probabilities	Matière				
Computer science 1 - Basics of algorithms, programming and computer architecture	UE				5 credits
Applied Informatics: Systems, Tools, Architectures	Matière				
Analysis and Programming method : Algorithmics	Matière				
Fluid Mechanics 1	UE				5 credits
Introduction to Fluid Mechanics	Matière				
Continuum mechanics	Matière				
Pratique Expérimentale en Mécanique des Fluides	Matière				
Fluid Mechanics 2	UE				5 credits
Thermodynamics	Matière				
Mechanics 1	UE				5 credits
Linear Elasticity	Matière				

Semestre 6-1A MF2E-N7

	Nature	CM	TD	TP	Crédits
SOFT AND HUMAN SKILLS 2	UE				5 credits

Elément à choix UE SHS S6 FISE	Élément constitutif				
English	Matière				
Sports	Matière				
Leadership Part 1 - S6	Matière				
Leadership Part 2 - S6	Matière				
Entrepreneuship Part 1 - S6	Matière				
Entrepreneurship Part 2 - S6	Matière				
Citizenship Part 1 - S6	Matière				
Citizenship Part 2 - S6	Matière				
Agile methods	Matière				
Managership P1-S6	Matière				
Managership P2-S6	Matière				
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
FSL - S6	Matière				
Mathematics 2	UE				5 credits
Finite Differences	Matière				
Statistics	Matière				
Introduction to optimization	Matière				
Signal Processing & Control systems	UE				5 credits
Signal and Automatic	Matière				
Fluid Mechanics 3	UE				5 credits
Flow at large Reynolds	Matière				
Low Reynolds Flows	Matière				
Bubbles, Drops and Particles	Matière				
Hydraulic Engineering	UE				5 credits
Numerical Methods - Finished Volumes	Matière				
Numerical Laminar Simulations - FLUENT Software	Matière				
Hydraulic Engineering	UE				5 credits
Integral Balances	Matière				
Hydraulics : Learning By Project	Matière				

Semestre 6-N7-1A Mécanique-GH FISE

	Nature	CM	TD	TP	Crédits
SOFT AND HUMAN SKILLS 2	UE				5 credits

Elément à choix UE SHS S6 FISE	Élément constitutif	
English	Matière	
Sports	Matière	
Leadership Part 1 - S6	Matière	
Leadership Part 2 - S6	Matière	
Entrepreneuship Part 1 - S6	Matière	
Entrepreneurship Part 2 - S6	Matière	
Citizenship Part 1 - S6	Matière	
Citizenship Part 2 - S6	Matière	
Agile methods	Matière	
Managership P1-S6	Matière	
Managership P2-S6	Matière	
Spanish	Matière	
Portuguese	Matière	
Chinese	Matière	
Italian	Matière	
Japonese	Matière	
Russian	Matière	
German	Matière	
French as a Foreign Language	Matière	
FSL - S6	Matière	
ELP à Choix	Choix	
Hydraulic Engineering	UE	5 credits
Integral Balances	Matière	
Hydraulics : Learning By Project	Matière	
Discovery in fluid mechanices	UE	5 credits
Introduction to flying	Matière	
Renewable energies	Matière	
Mathematics 2	UE	5 credits
Finite Differences	Matière	
Statistics	Matière	
Introduction to optimization	Matière	
Signal Processing & Control systems	UE	5 credits
Signal and Automatic	Matière	
Fluid Mechanics 3	UE	5 credits
Flow at large Reynolds	Matière	
Low Reynolds Flows	Matière	
Bubbles, Drops and Particles	Matière	
Hydraulic Engineering	UE	5 credits
Numerical Methods - Finished Volumes	Matière	
Numerical Laminar Simulations - FLUENT Software	Matière	

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique 2ème année

Semestre 7 MF2E Parcours N7-2A-Mécanique-GH FISE

	Nature	CM	TD	TP	Crédits
SOFT AND HUMAN SKILLS	UE				5 credits
Professional English 2.1 : Presentations	Matière				
2nd language	Bloc				
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S7	Matière				
Sports	Matière				
Leadership & Management	Matière				
FLUID MECHANICS 4	UE				5 credits
Complex Fluids	Matière				
Boundary Layers, Jet and laminar wakes	Matière				
FLUID MECHANICS 5	UE				5 credits
Turbulent Flows Introduction	Matière				
History of Fluid Mechanics	Matière				
SCIENTIFIC COMPUTING 2	UE				5 credits
Advanced use of CFD codes	Matière				
Numerical Methods for PDE	Matière				
Stochastic Processes	Matière				
TRANSFERTS	UE				5 credits
Heat and Mass Exchange	Matière				
Transfers in porous media	Matière				
MECHANICS 2	UE				5 credits
Wave dynamics	Matière				
Introduction to structure mechanics	Matière				

Semestre 8 MF2E FISE

	Nature	CM	TD	TP	Crédits
Parcours Eau et Environement S8	Choix				30 credits
SOFT AND HUMAN SKILLS	UE				5 credits
Professional English 2.2 : Debates	Matière				
Second language	Choix				

Spanish	Matière	
Spanish	Matière	
Chinese	Matière	
Italian	Matière	
Japanese	Matière	
Russian	Matière	
German	Matière	
french (as a foreign language)	Matière	
LSF - S8	Matière	
Sports	Matière	
Careers and Management - Sem.8	Choix	
Leadership	Matière	
Entrepreneurship	Matière	
Citizenship	Matière	
Managership-S8	Matière	
Choice of UE PROJECT MF2E S8	Choix	
Experimental Project	UE	5 credits
Experimental Project	Matière	
Numerical Project	UE	5 credits
Numerical Project	Matière	
Research project	UE	5 credits
Research project	Matière	
HYDRODYNAMICS AND STRUCTURES	UE	5 credits
Open channel flows	Matière	
TRANSFER IN POROUS MEDIA	UE	5 credits
Erosion and Solids Transport	Matière	
Eco-hydraulic	Matière	
CLIMATE PROJECT BASED LEARNING	UE	5 credits
Climate PBL	Matière	
Parcours Fluides et Procédés S8	**Choix**	**30 credits**
SOFT AND HUMAN SKILLS	UE	5 credits
Professional English 2.2 : Debates	Matière	
Second language	Choix	
Spanish	Matière	
Spanish	Matière	
Chinese	Matière	
Italian	Matière	
Japanese	Matière	
Russian	Matière	
German	Matière	
french (as a foreign language)	Matière	
LSF - S8	Matière	
Sports	Matière	
Careers and Management - Sem.8	Choix	
Leadership	Matière	
Entrepreneurship	Matière	

Citizenship	Matière				
Managership-S8	Matière				
Choice of UE PROJECT MF2E S8	Choix				
Experimental Project	UE				5 credits
Experimental Project	Matière				
Numerical Project	UE				5 credits
Numerical Project	Matière				
Research project	UE				5 credits
Research project	Matière				
AERODYNAMICS	UE				5 credits
Compressible Flows	Matière				
Gas turbomachines	Matière				
INDUSTRIAL SYSTEMS	UE				5 credits
Physical Analysis of Industrial Processes	Matière				
Thermodynamics of Machines	Matière				
Simulation Hydrodynamique et Transferts	Matière				
MULTI-SCALE PROCESSES	UE				5 credits
Vibration under flow	Matière				
Microfluidic Introduction	Matière				
TEDT : Turbulent Dispersion	Matière				

Ingénieur ENSEEIHT Mécanique et Génie Hydraulique 3ème année

Semestre 9 MF2E FISE

	Nature	CM	TD	TP	Crédits
Science de l'Eau et Environnement (SEE)	Parcours				30 credits
Soft and Human Skills MF2E S9	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				
Choix de Spécialité-SEE	Choix				
Spécialité-SEE	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				

Transport and Mixing	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
Spécialité-SEE-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
Spécialité-SEE-BD	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Spécialité-SEE-Aéro-BD	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Modélisation et Simulation Numérique (MSN)	Parcours	30 credits
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	

Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix de Spécialité-MSN	Choix	
Spécialité-MSN	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
Spécialité-MSN-Env	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
Spécialité-MSN-Enr	Bloc	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
Spécialité-MSN-Env-BD	Bloc	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	

MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits
Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
Fluide et Procédés (FEP)	**Parcours**	**30 credits**
Soft and Human Skills MF2E S9	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
CHOIX 2 sur 3 SHS MF2E S9	Choix	
Hydraulic operating control	Matière	
Controversies in a world in transition	Matière	
RSE (MF2E)	Matière	
CHOIX 1 sur 2 SHS MF2E S9	Choix	
Entrepreneurship Project	Matière	
Corporate Project and social responsability	Matière	
Choix Harmonisation	Choix	
HARMONISATION A7	UE	
Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
Choix de Spécialité-FEP	Choix	
Spécialité-FEP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	

ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc-Aéro	Bloc	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-Proc	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	

NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
Spécialité-FEP-FEIP	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
Spécialité-FEP-FEIP-Comb	Bloc	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Éco-Énergie (EE)	Parcours	30 credits

SYSTEMIC DESIGN	UE	5 credits
System modeling in Bond Graph	Matière	
Eco-design and LCA	Matière	
Hydrogen supply chain	Matière	
Optimization of energy processes and systems	Matière	
SMART-GRIDS	UE	5 credits
Decentralized, embedded electrical networks	Matière	
Energy Hybridization of Systems	Matière	
Smart grids	Matière	
RENEWABLE ENERGIES	UE	5 credits
Wind Power Systems	Matière	
Photovoltaic APP	Matière	
Low-Power Hydroelectric Installations	Matière	
GENERAL TRAINING	UE	5 credits
Professional English-LV1-Semestre 9	Bloc	
Anglais Scientifique	Matière	
Choix 2 Anglais Professionnel - 3A	Choix	
Anglais Clinique	Matière	
Anglais de Cambridge ou Projet	Matière	
Themed Day: Energy and Sustainable Development	Matière	
Impact Entrepreneurship from Low to Deep Tech MF2E	**Parcours**	**30 credits**
Choix UE Hard Skills MF2E Parcours Impact Entrepreneurship	Bloc	
Choix UE Parc. MSN Parc. Impact Entrepreneurship	Choix	
MODELING	UE	5 credits
Models for Interfaces	Matière	
Modélisation de la turbulence	Matière	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
HIGH PERFORMANCE COMPUTING	UE	5 credits
Advanced Languages for programming	Matière	
Advanced Techniques for Scientific computing	Matière	
Meshing, Pre and Post Processing	Matière	
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE	5 credits
Numerical project for Compressible Flows	Matière	
Numerical project for Incompressible Flows	Matière	
Industrial codes	Matière	
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE	5 credits
Numerical methods for incompressible flows	Matière	
Numerical methods for compressible flows	Matière	
Data Assimilation	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	

TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
Choix UE Parc. SEE Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
ENVIRONMENTAL FLOWS	UE	5 credits
Atmospheric boundary layer	Matière	
Coastal Hydrodynamics	Matière	
Transport and Mixing	Matière	
BIG DATA AND GEOSCIENCES	UE	5 credits
Mathematical methods for exploiting data	Matière	
Using artificial intelligence for forecasting	Matière	
HYDROLOGY	UE	5 credits
The Hydrology of Transfers	Matière	
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière	
INSTALLATION AND WORKS	UE	5 credits
Soil mechanics	Matière	
Engineering of hydraulic works	Matière	
Impacts of industrial developments on the environment	Matière	
Risk and Prevention	Matière	
ADVANCED HYDRAULIC MODELING	UE	5 credits
Geographic Information System	Matière	
Advanced Free Surface Flow Modelling	Matière	
Sediment Transport and Morphodynamics	Matière	
Environmental numerical codes	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
Choix UE Parc. FEP Parc. Impact Entrepreneurship	Choix	
APPLICATION TO AERODYNAMICS	UE	5 credits
Aérodynamique	Matière	
Aéroacoustique	Matière	
Fluid Structure Interaction	Matière	
TURBULENCE AND MULTIPHASE FLOWS	UE	5 credits
Physics of incompressible turbulent flows	Matière	
Two phase flows	Matière	
Transfers in two-phase and turbulent media	Matière	
TRANSITION AND RENEWABLE ENERGIES	UE	5 credits
Energy transition and renewable energies	Matière	
HARMONISATION A7	UE	

Initiation Linux/Harm.A7	Matière	
Reminder of fluids mechanics and introduction to turbulence	Matière	
Dynamics of bubbles, drops and particles	Matière	
HARMONISATION N7	UE	
Material transfer	Matière	
Reactor sizing	Matière	
MULTIPHASE FLOWS PROCESSES	UE	5 credits
Two-phase flows with phase changes	Matière	
Two-phase hydraulics	Matière	
Coalescence Rupture Aggregation	Matière	
NUMERICAL SIMULATIONS - PROCESS	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Digital Disphasic	Matière	
Simulation of industrial flows	Matière	
Multiphysics coupling	Matière	
PROCESSES : PHYSICS AND MODELLING	UE	5 credits
Microfluidique	Matière	
Energy optimization of thermodynamic steam cycles	Matière	
Transfer in Porous media	Matière	
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE	5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière	
Simulation of industrial flows	Matière	
Simulation of a fluidised bed	Matière	
REACTIVE MEDIA	UE	5 credits
Combustion	Matière	
Piston engines Project	Matière	
ECOULEMENTS FLUIDE-PARTICULES	UE	5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière	
Gas-particle flows	Matière	
Granular media	Matière	
SOFT SKILLS 1 - PARTNERSHIPS	UE	5 credits
UT ou TBS ou TSM 1 - module 18h	Matière	
UT ou TBS ou TSM 2 - module 18h	Matière	
UT ou TBS ou TSM 3 - module 18h	Matière	
SOFT SKILLS 2 - DESIGN THINKING	UE	5 credits
Design Thinking 1 - module 15h	Matière	
Design Thinking 2 - module 18h	Matière	
Professional Communication and English - module 21h	Matière	
SOFT SKILLS 3 - PROJET DEEP TECH & APPLICATIONS	UE	5 credits
PDT & CU 1 - module 18h	Matière	
PDT & CU 2 - module 18h	Matière	
PDT & CU 3 - module 18h	Matière	
Génie de l'Environnement (GE)	Parcours	30 credits
GE - Harmonisation	UE	2 credits
GE - Chimie des solutions	Élément constitutif	

GE - Hydraulique - Introduction à l'hydrologie	Élément constitutif				
GE - Agro-écosystèmes	Élément constitutif				
GE - SIG	Élément constitutif				
GE - Gestion de l'eau	UE				5 credits
GE - Gestion des déchets	UE				5 credits
GE - Industries et milieux naturels	UE				5 credits
GE - Economie circulaire	UE				5 credits
GE - Projet long	UE				4 credits
GE - Approfondissement	Bloc				4 credits
GE - Impacts Anthropiques	UE				4 credits
GE - Ingenierie de l'aménagement	UE				4 credits
GE - Ingenierie du développement soutenable	UE				4 credits

Semestre 10 à l'N7-3A-MF2E

	Nature	CM	TD	TP	Crédits
PFE FISA	UE				30 credits
PROJET FIN D'ETUDES MF2E SANS PROJET LONG	UE				30 credits
Stage 2A MF2E	Matière				6 credits
PFE MF2E sans PL	Module				24 credits
PFE MF2E avec PL	UE				
PROJET LONG MF2E	Matière				8 credits
PROJET DE FIN D'ETUDE-MF2E	Matière				16 credits
Stage 2A MF2E	Matière				6 credits

Soft and Human Skills

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01

List of courses

	Nature	CM	TD	TP	Crédits
Anglais	Matière				
Second language	Choix				
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S5	Matière				
Sports	Matière				
Leadership and management	Matière				

Anglais

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 21
- **Ametys Code:** N5EK01A

Presentation

Objectives

Perform key oral and written workplace tasks in English.

Description

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

Pre-requisites

Aucun.

Second language

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01B
- **Open to exchange students:** No

Presentation

Description

Develop professional communication skills by performing common written and oral communication tasks in foreign languages other than English.

List of courses

	Nature	CM	TD	TP	Crédits
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S5	Matière				

Spanish

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BA

Portuguese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BB

Chinese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BC

Italian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BD

Japonese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BE

Russian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BF

German

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BG

French as a Foreign Language

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01BH

LSF - S5

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9T6NG

Sports

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EK01C
- **Open to exchange students:** No

Presentation

Objectives

- Health seen as a set of resources that need to be mobilized and developed.
- Self-knowledge through effort.
- Access to an area of culture.

Description

- Choose a sport from a list of twenty or so (activities to suit all tastes).
- A weekly sports slot.
- Training and Cross at the end of semester 1.

Leadership and management

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 21
- **Ametys Code:** N5EK01D

Presentation

Objectives

Develop key professional competencies to communicate effectively, manage projects and work in international teams.

Description

1 semester of 12 weekly sessions aimed to develop your personal professional project.

Pre-requisites

None.

Mathematics 1

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM01

List of courses

	Nature	CM	TD	TP	Crédits
Integration	Matière				
Probabilities	Matière				

Integration

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM01A

Presentation

Objectives

The purpose of the course is to become acquainted with the Lebesgue integral and the use of the theory of integration, as it is involved in the tools for signal processing regarding integral transforms. The concept of distribution is also introduced as it is essential fo the generalization of basic operations as derivation, convolution or Fourier transform.

Description

Measure theory.
Measurable function, simple function integration.
Convergence theorems, Leibniz integral rule.
Lp spaces.
Distribution, derivation and convolution.
Fourier and Laplace transforms.

Probabilities

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM01B
- **Open to exchange students:** No

Presentation

Objectives

Understand how to define discrete and continuous random variables and the related basic tools (mathematical expectation, probability density function, cumulative distribution function, characteristic function, change of variables)

Understand how to define random vectors and how to compute marginal distributions, conditional distributions, mathematical expectations with a particular interest to the covariance and the correlation coefficient. Understand the different steps required for changes of variables for random vectors.

Understand how standard probabilistic notions simplify for random Gaussian vectors (margins and conditional distributions, affine transformations, independence). Introduce chi-square, Student and Fisher distributions.

Understand the different notions of convergence (in distribution, in probability, in the mean square sense) and the interest of the law of large numbers and the central limit theorem.

Description

- Definition of a probability space
- Discrete and continuous random variables
- Random vectors
- Gaussian vectors
- Convergence and limit theorems

Pre-requisites

Probability bases (conditional probabilities, theorem of total probabilities, Bayes theorem), Calculus of integrals and series, change of variables, basic elements of linear algebra

Useful info

Contacts

Responsable pédagogique

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Computer science 1 - Basics of algorithms, programming and computer architecture

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N5EM02

Presentation

Objectives

Write a computing program to solve a problem of mecanics or physics, using basic algorithms and programming in a linux environment.

Pre-requisites

None

List of courses

	Nature	CM	TD	TP	Crédits
Applied Informatics: Systems, Tools, Architectures	Matière				
Analysis and Programming method : Algorithmics	Matière				

Applied Informatics: Systems, Tools, Architectures

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM02A

Presentation

Objectives

Present the computer resources available at the ENSEEIHT while performing a student upgrade on mastering the tools and understanding how they work.

Description

1. Presentation of office automation tools (word processor and spreadsheet).
2. Introduction to the architecture of computers.
3. Concepts and properties of an operating system.
4. Initiation to Unix: file system, main commands, shells.
5. From the program to the process (interpreted languages, compiled languages, compilers, link editing, execution).

Analysis and Programming method : Algorithmics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM02B

Presentation

Objectives

Develop a methodology so that a physicist can write a computer program using algorithmic and programming.

Description

- Decomposition method of a simple program: sequence, loop.
- Definition of input data, output data and functionality of a program.
- Introduction of a main program, subroutine and file.
Translation into the Fortran 90 language.

Pre-requisites

None

Useful info

Contacts

Responsable pédagogique

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Fluid Mechanics 1

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N5EM03

Presentation

Objectives

At the end of this teaching unit, first-year engineering students will be able to:

- to describe a set of applications of fluid mechanics
- to produce a dimensional analysis from a physical model
- to explain the physical meaning of the different terms of the fluid mechanics equations
- to use the tools of algebra to manipulate the equations of fluid mechanics
- to generate analytical solutions of the Lamé and Navier-Stokes equations

Description

The topics covered in this teaching unit are:

- Dimensional analysis.
- Mass, momentum or energy budgets
- Understanding of the terms of the constitutive equations for elastic and fluids mechanics.
- Analytical solutions of the Navier-Stokes
- Coupling between thermodynamics and compressible fluids.

The assessment is composed as follows:

- Three written exams (1:45 each): 75%
- Three Practical Work (4h each): 25%

The 1h45 pedagogical sequences are distributed as follows:

- 15 Magistrates Courses
- 13 Tutorials
- 1 Pratical case study
- 2 Inverted classes

List of courses

	Nature	CM	TD	TP	Crédits
Introduction to Fluid Mechanics	Matière				
Continuum mechanics	Matière				
Pratique Expérimentale en Mécanique des Fluides	Matière				

Useful info

Contacts

Responsable pédagogique

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Introduction to Fluid Mechanics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM03A

Presentation

Objectives

This course precedes the "continuum mechanics" course where the Navier-Stokes equations are derived and implemented in some academic situations presenting an accessible analytical solution. The purpose of this course is to provide a physical insight into some basic problems in fluid mechanics via dimensional analysis and analysis using orders of magnitude. It introduces dimensionless numbers and adimensionalization of an equation system. At the end of the course, students will be able to:

- to master the vocabulary used to classify the flows and physical phenomena observe.
- to produce a dimensional analysis of a physical problem.
- to make dimensionless an equation system for a physical problem.
- to explain the physical meaning of the different terms of the conservation equations and to use them to analyze with the hands a problem.

Description

1. Illustration of classical flows and discovery of vocabulary to describe the flows and physical phenomena observed.
2. Physical Analysis of Navier-Stokes Equations. The two viscosities. Transport mechanisms. Capillary effects.
3. Dimension and adimensionalization of the quantities and equations. Discussion on studies in similarities
4. The Pi / Vaschy Buckingham theorem and application for solving simple physical problems.
5. Law of scales and problem solving by manipulation of orders of magnitude.

Two sessions of TP.

TP1 in wind tunnel for implementation of the concepts of aerodynamic forces and coefficient of drag and lift. Study of similarity

TP2: Reynolds experiment. Flow regime, laminar / turbulent, pressure drop. Taylor-Couette flow transitions.

Continuum mechanics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** Presential 50
- **Ametys Code:** N5EM03B

Presentation

Objectives

This course allows to assimilate the basic formalism of the mechanics of the continuous environments leading to the writing of the Lamé and Navier-Stokes equations.

At the end of the first part of the course, freshmen will be able to:

- to use the formalism of the linear algebra to follow the demonstrations leading to the equations of the mechanics of the continuous mediums;
- explain the transformations between volumes and surfaces in the balance equations;
- describe behavioral laws for the diffusion of heat or the rheology of elastic solids;
- calculate analytical solutions for simple linear elasticity problems.

At the end of the second part of the course, freshmen will be able:

- to describe the kinematics of the flows using matrices expressing the rotation or the deformation of the particles;
- to formulate the conservation equations of mass, momentum and energy;
- to describe behavioral laws for the Newtonian fluid rheology;
- to calculate analytical solutions for simple fluid mechanics problems.

Description

1) Linear algebra and tensors: Einstein convention, differential operators, the divergence formula
2) The continuum hypothesis: heat flux vector by small tetrahedra, Fourier law and state law leading to the heat equation.
3) Large and small deformations: Jacobian matrice, dilatation tensor and small strains tensor, Jacobian.
4) Stress tensor under small strains: mass conservation in Lagrangian representation, fundamental principle of dynamics, existence and symmetry of the stress tensor.
5) Lamé equations : Hooke's Law, longitudinal and transverse waves in solids.
6) Kinematics: trajectories, streamlines, particle spin.
7) Transport theorems: rotation vector and tensor strain rate, pass on a moving domain.

8) incompressible Navier-Stokes equations: fundamental principle of the dynamics, law of behavior.
9) Compressible Navier-Stokes equations: "theorem" of kinetic energy and power of internal forces, first principle of thermodynamics.
A session of Practical Work (4h): "Hydraulic jump", to illustrate the notion of discontinuity and jump relation.

Useful info

Contacts

Responsable pédagogique

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Responsable pédagogique

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Pratique Expérimentale en Mécanique des Fluides

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9TEAO

Fluid Mechanics 2

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM04

List of courses

	Nature	CM	TD	TP	Crédits
Thermodynamics	Matière				

Thermodynamics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM04A

Presentation

Objectives

Learning of the first and second law of thermodynamics in order to apply them on classical installations (turbine, compressor, heat exchangers, motors,...)

Description

This course begins with the basis of thermodynamics with the two first laws, the state equation formulation, the use of thermodynamical potentials, models of simple system, phase change and air humidity

Mechanics 1

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM05

List of courses

	Nature	CM	TD	TP	Crédits
Linear Elasticity	Matière				

Linear Elasticity

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5EM05B

Presentation

Objectives

The aim of the course is to propose a short introduction to linear elasticity. The student must become familiar with the use of stress and strain tensors. The resolution of plane elasticity problems by Airy function is presented and stress field solutions of simple geometries are established (bending of a beam, torsion of a circular bar, plate with a hole, cylindrical container under pressure, gravity dam...).

Description

1. Infinitesimal strain.
2. Stress tensor.
3. Constitutive law of linear elasticity of an isotropic homogeneous media (Hooke law).
4. Displacement and stress formulations : Navier/Lamé and Beltrami-Michell equations.
5. Plane elasticity.

SOFT AND HUMAN SKILLS 2

ECTS
5 credits

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

In brief

- **Ametys Code:** M4IJYC4P

List of courses

	Nature	CM	TD	TP	Crédits
Elément à choix UE SHS S6 FISE	Élément constitutif				
English	Matière				
Sports	Matière				
Leadership Part 1 - S6	Matière				
Leadership Part 2 - S6	Matière				
Entrepreneuship Part 1 - S6	Matière				
Entrepreneurship Part 2 - S6	Matière				
Citizenship Part 1 - S6	Matière				
Citizenship Part 2 - S6	Matière				
Agile methods	Matière				
Managership P1-S6	Matière				
Managership P2-S6	Matière				
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
FSL - S6	Matière				

Elément à choix UE SHS S6 FISE

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

In brief

- **Ametys Code:** M23F371L

List of courses

	Nature	CM	TD	TP	Crédits
English	Matière				
Sports	Matière				

	Nature	CM	TD	TP	Crédits
Leadership Part 1 - S6	Matière				
Leadership Part 2 - S6	Matière				
Entrepreneuship Part 1 - S6	Matière				
Entrepreneurship Part 2 - S6	Matière				
Citizenship Part 1 - S6	Matière				
Citizenship Part 2 - S6	Matière				
Agile methods	Matière				
Managership P1-S6	Matière				
Managership P2-S6	Matière				

	Nature	CM	TD	TP	Crédits
Spanish	Matière				
Portuguese	Matière				
Chinese	Matière				
Italian	Matière				
Japonese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
FSL - S6	Matière				

English

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 21
- **Ametys Code:** N6EK01A

Presentation

Objectives

Develop professional communication competencies by completing key written and oral tasks in English.

Description

1 semester of 12 interactive, weekly sessions in English.

Pre-requisites

None

Sports

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01C
- **Open to exchange students:** No

Presentation

Objectives

- Health seen as a set of resources that need to be mobilized and developed.
- Self-knowledge through effort.
- Access to a cultural domain.

Description

- Choose a sport from a list of twenty or so (activities to suit all tastes).
- A weekly sports slot.
- Training and Cross at the end of semester 1.

Leadership Part 1 - S6

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

In brief

- **Ametys Code:** M23F37SV
- **Open to exchange students:** No

Presentation

Objectives

1. Explore the concept of sustainable development & civic engagement.
2. Extend knowledge of different examples, workplace activities & issues, frameworks.
3. Study the concepts of life cycle analysis, eco-design, decarbonization.
4. Apply key concepts to a team civic engagement project proposal.
5. Present and defend a team civic engagement project proposal.

Description

By the end of the module, students will have :
effectively planned and executed projects using traditional methods, focusing on aspects such as Gantt charts, critical path analysis, and resource allocation.
analyzed and compared basic project management approaches with other methodologies, particularly understanding the context in which project management is most effective.
applied basic project management techniques to real-world or simulated case studies.

efficiently conducted and facilitated meetings with project clients and stakeholders, focusing on techniques to maximize time and cost efficiency.

Leadership Part 2 - S6

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

In brief

- **Ametys Code:** M23F37VT
- **Open to exchange students:** No

Presentation

Objectives

1. Raise awareness of diversity issues in the workplace and the topics that need to be addressed in order to improve equality
2. Identify the impact of empathy and mindful leadership styles
3. Enhance the capacity to make difficult decisions, particularly in sensitive or ambiguous situations
4. Develop critical thinking, analytical and professional communication soft skills.

Description

By the end of this 5-week course students will have
gained a comprehensive understanding of what leadership is and how to become an effective leader;
participated in a diversity serious game and gained insights into diversity topics relevant to leaders;
reflected on ethical scenarios which can arise in a workplace, and how to best manage issues with integrity

developed their professional networking and communication skills to interview a mentor about leadership and diversity in their workplace with the view to gaining experiential insights.
Engaged in leadership role plays to gain insights into the multi dimensional aspects of considerations that need to be taken into account when leading with diversity

Entrepreneuship Part 1 - S6

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

In brief

- **Ametys Code:** M23F37ZZ
- **Open to exchange students:** No

Presentation

Objectives

Develop basic entrepreneurial knowledge and skills

.

Session 1 + 2: Basic financial management (costs, revenues, profitability)
Understanding financial indicators
Strategic financial decision-making
Ability to analyze and plan budgets
Autonomy in managing your business.
Session 3 + 4: Presenting your project
Communication skills and storytelling
Structuring and clarity of speech
Effective pitch techniques
Stress management and public speaking
Synthesis and persuasion skills.
Session 5 + 6: Creating opportunities and integrating into an ecosystem :
Developing your professional network
Identifying and exploiting opportunities
Negotiation skills and partnership relations

Entrepreneurial spirit and proactive posture
Ability to receive and integrate feedback

Translated with DeepL.com (free version)

Description

By the end of this module, students will have adopted a
‘design thinking’ entrepreneurial approach to develop the basic knowledge and skills
relating to their entrepreneurial posture.

Entrepreneurship Part 2 - S6

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

In brief

- **Ametys Code:** M23F383B
- **Open to exchange students:** No

Presentation

Objectives

Key Skills to be developed:
Foundational financial knowledge
Practical tools for entrepreneurial decision-making
Analytical skills for interpreting financial data.

Description

This course helps students gain essential financial knowledge and skills to adopt an entrepreneurial mindset, focusing on fundamental concepts of accounting, financial analysis, and decision-making.

Citizenship Part 1 - S6

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

In brief

- **Ametys Code:** M23F3860
- **Open to exchange students:** No

Presentation

Objectives

Are you one of those people who believe that SHS (Humanities and Social Sciences) are not "real sciences", like mathematics or physics? Do you believe that everything teachers say is true ? Do you believe that most knowledge is acquired by reading texts? If so, you probably have a somewhat naive view of science. This course is designed to help you take stock of your beliefs about knowledge and science - what we call epistemological beliefs. By the end of this course, you'll be able to take an (even) more critical look at knowledge, the sciences, teachers and the subjects you're taught at school.

Description

1. At the end of Part #1, students will be able to analyze their personal conception of science. They will take a critical look at their personal vision of certain aspects of scientific knowledge such as, for example, the empirical, theoretical, creative and imaginative nature of scientific knowledge, its social and cultural roots, and its provisional nature

.
2. At the end of Part #2, students will develop their own definition of engineering
as an applied science.
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3. By the end of Part #3, students will draw up an inventory of the
epistemological factors they believe influence the constitution of a knowledge base in engineering.
ingénierie.

Citizenship Part 2 - S6

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

In brief

- **Ametys Code:** M23F389W
- **Open to exchange students:** No

Presentation

Objectives

Familiarize yourself with the notion of Corporate Social Responsibility, understand its
foundations and the associated societal issues.
Be able to analyze and evaluate a company's overall CSR approach.
Learning outcomes: By the end of this course, students will have mastered concepts and multidisciplinary methodological tools enabling them to - -
characterize the conditions for implementing a CSR approach;
diagnose the CSR approach and identify options for improvement.

Description

Comparative case studies of companies that have developed a CSR approach (summary of
4 pages and oral presentation).

Agile methods

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

In brief

- **Ametys Code:** M23F38CW
- **Open to exchange students:** No

Presentation

Description

Develop your knowledge and skills in project management and agile methods.

Managership P1-S6

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

In brief

- **Ametys Code:** M23F38GB
- **Open to exchange students:** No

Presentation

Objectives

1. To gain an awareness of key topics related to organizational and managerial & features;
2. To understand key organizational and management phenomena experienced in professional life;
3. To put theoretical input into practice, and use tools and analytical grids to understand current companies and their related developments.

Description

By the end of the module, students will have developed:
Knowledge: students will be able to name key generic characteristics of organizational structure, culture and managerial processes and how they influence daily organizational and managerial action.
Know-how: students will be able to analyze organizational and managerial features to understand how they function, their intertwinement, and impacts on the daily functioning of companies.
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Managerial competencies: interpersonal abilities through team work (case study and collective analysis), particularly negotiation, managing possible disagreements, articulating and expressing their thoughts to others.
Other competencies: oral presentation skills in a professional format, summarizing the results of their analysis and rephrasing them in public; defending their arguments, analysis and findings.

Managership P2-S6

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

In brief

- **Ametys Code:** M23F38JM
- **Open to exchange students:** No

Presentation

Objectives

Learning objectives:
Identify your own profile and those of others to improve collaboration and understanding;
Identify the strengths of your soft skills (EQ-I) to use them in the team setting;
Develop your ability to communicate effectively using your strengths.
Regulate conflicts.
Develop cross-functional skills
Managerial skills addressed and worked on
Speaking in front of a group, posture and ability to convince and debate
International - The concepts of management leadership, team cohesion and soft skills as used are derived from international work and research.
Social and environmental responsibility - Understanding the issues of Quality of Life at Work and psychosocial risks thanks to the concepts covered in

emotional intelligence and soft skills development.

Description

Learning outcomes: At the end of this intervention, the student will have

have identified their personal functioning and potential;
will have identified his or her managerial posture, particularly in managing conflicts;
be able to regulate stress more easily.

Spanish

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BA
- **Open to exchange students:** No

Presentation

Description

Develop professional communication competencies by completing key written and oral tasks in Spanish.

Portuguese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BB
- **Open to exchange students:** No

Presentation

Description

Develop professional communication competencies by completing key written and oral tasks in portuguese.

Chinese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BC
- **Open to exchange students:** No

Presentation

Description

Develop professional communication competencies by completing key written and oral tasks in Chinese.

Italian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BD
- **Open to exchange students:** No

Presentation

Description

Develop professional communication competencies by completing key written and oral tasks in italian.

Japonese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BE
- **Open to exchange students:** No

Presentation

Description

Develop professional communication competencies by completing key written and oral tasks in Japanese.

Russian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BF
- **Open to exchange students:** No

Presentation

Description

Develop professional communication competencies by completing key written and oral tasks in russian.

German

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BG
- **Open to exchange students:** No

Presentation

Description

Develop professional communication competencies by completing key written and oral tasks in german.

French as a Foreign Language

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EK01BH
- **Open to exchange students:** No

Presentation

Description

Develop your professional communication skills by performing common written and oral communication tasks in French as a foreign language.

FSL - S6

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

In brief

- **Ametys Code:** M23F3AG1
- **Open to exchange students:** No

Presentation

Description

Develop your professional communication skills by performing common communication tasks and gestures in French Sign Language.

Mathematics 2

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM01

List of courses

	Nature	CM	TD	TP	Crédits
Finite Differences	Matière				
Statistics	Matière				
Introduction to optimization	Matière				

Finite Differences

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N6EM01A
- **Open to exchange students:** No

Presentation

Objectives

At the end of this course, the student must be able to propose a relevant discretization for a linear PDE using the finite difference method and to analyze the convergence (consistency and stability) and accuracy.

Description

The finite difference method is first introduced for the discretization of the model equations (advection equation and diffusion equation). Convergence (consistency and stability) and precision analysis techniques are discussed using the Lax theorem and the matrix method. These analysis tools are then used to choose discretization schemes adapted to each of the linear EDP families. The analysis of the error committed (diffusion, dispersion) is finally introduced.

Statistics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 6 lectures of 1
- **Ametys Code:** N6EM01B

Presentation

Objectives

Understand how to define a statistical model, to determine the main properties of estimators of the model parameters and finally to implement standard estimation methods (maximum likelihood, methods of moments, Bayesian estimators, confidence intervals)

Understand the concept of statistical test, how we can evaluate the performance of a test and how the Neyman Pearson theorem can be applied to binary hypothesis problems.

Understand the principles of goodness of fit tests (chi-square and Kolmogorov)

Description

Estimation

- Statistical model and properties of estimators

- Cramér-Rao inequality

- Maximum likelihood

- Method of Moments

- Bayesian estimation

- Confidence intervals

Binary hypothesis tests

- Probability of false alarm, of detection and receiver operational characteristics (ROCs)

- Neyman Pearson theorem

- Chi-square and Kolmogorov tests

Pre-requisites

Bases of probability theory, computation of integrals and series, bases of optimization theory and of linear algebra

Useful info

Contacts

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Introduction to optimization

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM01C

Presentation

Objectives

Learn the basics of optimization methods: decision variables, objective function, minimization of nonlinear problems, least squares problems, minimization under stress
  numerical optimization approach: iterative gradient methods; least squares problems; other numerical methods such as simulated annealing; network / graph problems

Description

1. Free and constrained minimization, Lagrange multipliers, convexity
2. Application 1: Nonlinear Regression, Model Registration,
3. Application 2: Newton's method for finding equilibrium points
4. Functional optimization
5. Application: minimal surfaces

Signal Processing & Control systems

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM02

List of courses

	Nature	CM	TD	TP	Crédits
Signal and Automatic	Matière				

Signal and Automatic

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N6EM02A

Presentation

Objectives

The objective is to acquire tools of the engineer in deterministic signal processing and automatic continuous time, for a first approach of the main aspects related to the mechanical vibrations in an industrial context: the modeling, the measurement, the control. Localized parameter modeling (lumped parameters) is preferred.

Description

The module consists of two parts:

I Modal Experimental Analysis (4 CM, 6TD, 1TP):

- SLI Model Linear Invariant System

- Introduction to the concepts of organization and interaction.

- Frequency Response Function (F.R.F).

- Oscillatory and aperiodic mode. Stability.

- Convolution property. Memory effect.

- Filtering (RII, RIF).

- Introduction to the signal concept (Fourier analysis)

- Digital identification techniques

- Consequences of temporal truncation (spectral leakage, resolution)

- Time Sampling Effects (Spectral Folding, Shannon's Th.)

- Discrete TF (reciprocal Shannon th)

- TP Modal Experimental Analysis: Modal identification (impact hammer) and detection of defects of a rotating machine (real-time monitoring by Simulink RTW, problem of starting and stopping machine). Resonance and anti-resonance of a 2 ddl system.

II APP Vibrations Under Control (project by team)

- Through Project Based Learning, students acquire basic concepts and knowledge to control a hydromechanical process. The teaching team (5 tutors, one expert) has defined the following learning objectives:

- The concept of system to represent a physical process.

- Knowing how to translate the organization (the natural or artificial interactions) of a system by a recursive functional diagram (looped).

- To be able to translate the phenomena of his specialty, by associations of elementary models: Inertial effect, Resistive, Capacitive.

- Identify a basic hydromechanical process by analyzing the response to a deterministic solicitation (behavior model)

- Linearize a nonlinear model around an operating point to obtain a model L.T.I. (Linear Invariant System) in transfer.

- Determine the stability of a system controlled by the Nyquist criterion.

- Understand the risks of looped architecture (influence of phase delays on stability).

- Understand the interest of the looped architecture for performance (for stability, to manage disturbances).

- Know how to adapt a Proportional controller taking into account the antagonisms between performances (stability / precision, speed / sensitivity to noise). An "agile coach" accompanies teams for project management (SCRUM method).

Fluid Mechanics 3

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM03

List of courses

	Nature	CM	TD	TP	Crédits
Flow at large Reynolds	Matière				
Low Reynolds Flows	Matière				
Bubbles, Drops and Particles	Matière				

Flow at large Reynolds

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N6EM03A

Presentation

Objectives

To assimilate the formalism of the potential flows with the aim of introducing bases for the Reynolds large flow modeling and in particular for aerodynamics. An introduction to the dynamics of vorticity is also proposed.

Description

-Superposition of potential flows.

-Efforts exerted by a potential flow on an obstacle (formulas of Blasius). D'Alembert's paradox, Joukowsky's theorem.

-Condition of Kutta.

-Method of the conformal transformation to obtain the lift of a wing profile (example of the transformation of Zhukovsky).

-Basic notion of swirling dynamics.

This teaching will be divided n into 5 Courses and 6 TDs.

Low Reynolds Flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 12,25
- **Ametys Code:** N6EM03B

Presentation

Objectives

The object of this course is to describe the particular hydrodynamic phenomena that one encounters with small Reynolds numbers . The basic equations are commented, analyzed and solved in simple geometries.

Description

Introduction: Re << 1 What is inertia? and applications
Basic equations and different formulations
Specific properties (linearity, reversibility, reciprocity) and consequences.
Fundamental Solutions of Stokes Equations
Cellule of Hele-Shaw
Lubrication (hydraulic bearing)
Flows in thin layers
Calculation of the stokes force

Pre-requisites

Méca Fluides 1

Bubbles, Drops and Particles

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N6EM03C

Presentation

Description

I. Bubbles, drops and particles (5 class sessions, 2 TD sessions)

1) Introduction: Industrial and Environmental Issues bubbles drops and particles of energetics and processes to the environment.

2) The different types of particles. Nature of the particle vs condition surface (notion of surfactant) Structure of flow and wake / production of vorticity Shape effect (deformability of fluid particles: spherical, ellipsoidal, foolish) => limitation of course.

3) Terminal speed (<=> The drag) for each case: solution with the hands (physical arguments) then analytical solution.

3a) Stokes Law: Viscous regime

3b) Newton's law: inertial regime

3c) Levich's Law (Dissipation of Viscous Lead Flow)

4) Mass added Kinetic energy, impulse, drift

5) Trajectory

5a) Maxey decomposition

5b) Archimedes generalized

5c) Relaxation time

5d) Number of Stokes Rq: a number of dynamic effects (to be defined) will have to be left out (and will be seen in 3H). For example, history, lift, magnus.

Hydraulic Engineering

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM04

List of courses

	Nature	CM	TD	TP	Crédits
Numerical Methods - Finished Volumes	Matière				
Numerical Laminar Simulations - FLUENT Software	Matière				

Numerical Methods - Finished Volumes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM04A

Presentation

Objectives

Understand the fundamental concepts of the Finished Volumes approach. Knowing how to pass from a physical problem continues to its discretized form in finite volumes.

Description

Introductions to the Finite Volumes method. The principle of the method is introduced and the steps of the implementation are detailed on the basis of simple examples (convection / diffusion equation) in order to allow easy passage to the coding. The Associate Design Office sessions consist of the development of a program written in FORTRAN language and operated on a microcomputer.

Numerical Laminar Simulations - FLUENT Software

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 17.5
- **Ametys Code:** N6EM04B

Presentation

Objectives

Present the structure of a generalist fluid mechanics code.
Give a method in order to decompose a physical problem.
Interpret and criticize the results of the code.

Description

Presentation of the structure of the generalist codes of fluid mechanics. - Learn to ask and then break down a physical problem. - Introduce this decomposition in an industrial calculation code (Fluent at present). - Interpret and critique the results of the code on various classic examples of the first-year fluid mechanics course.

Pre-requisites

Basic Fluid mechanics course

Basis in scientific computing

Hydraulic Engineering

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM05

List of courses

	Nature	CM	TD	TP	Crédits
Integral Balances	Matière				
Hydraulics : Learning By Project	Matière				

Integral Balances

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM05A

Presentation

Objectives

Establish integral balance equations governing the dynamic of homogeneous fluids

Description

Application of the principles of Newtonian mechanics and thermodynamics

Pre-requisites

Introduction to fluid mechanics
Continuum mechanics
Mathematical tools for fluid mechanics

Useful info

Contacts

Responsable pédagogique

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Hydraulics : Learning By Project

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM05B

Presentation

Objectives

External link towards the pitch of the course

It's about being able to calculate pressure losses in a hydraulic network by reading a Moody diagram or by developing an ad hoc digital program. The calculation of quantities related to a hydraulic jump is a second objective. Finally, the establishment of links between hydraulics and fluid mechanics is an integral part of this teaching.

This teaching combines several educational formulas:

- Traditional Transmissive Education (ETT): Teachers expose knowledge through lectures and tutorials.
- Project Apprenticeship (APP): the realization of projects motivates a search for useful information, independently.
- Progress in Groups (PEG): An individual course work is followed by group discussions and collaborations.

Description

The hydraulics in charge processes pressurized flows in closed conduits. Free surface hydraulics treat flows in open channels. The essential notions are:

- Hydraulic load
- Linear load losses
- Singular charge losses

Hydraulic machines refer to pumps as well as turbines. The essential notions are:

- The three types of pumps
- Load balance and yields
- Operating parameters

Useful info

Contacts

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ELP à Choix

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EMAX

List of courses

	Nature	CM	TD	TP	Crédits
Hydraulic Engineering	UE				5 credits
Integral Balances	Matière				
Hydraulics : Learning By Project	Matière				
Discovery in fluid mechanices	UE				5 credits
Introduction to flying	Matière				
Renewable energies	Matière				

Discovery in fluid mechanics

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM06

List of courses

	Nature	CM	TD	TP	Crédits
Introduction to flying	Matière				
Renewable energies	Matière				

Introduction to flying

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM06A

Renewable energies

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6EM06B

SOFT AND HUMAN SKILLS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01
- **Open to exchange students:** No

List of courses

	Nature	CM	TD	TP	Crédits
Professional English 2.1 : Presentations	Matière				
2nd language	Bloc				
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S7	Matière				
Sports	Matière				
Leadership & Management	Matière				

Professional English 2.1 : Presentations

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 21
- **Ametys Code:** N7EK01A

Presentation

Objectives

Perform key oral and written workplace tasks in English.

Description

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

Pre-requisites

None.

2nd language

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01B
- **Open to exchange students:** No

Presentation

Description

Develop professional communication skills by performing common written and oral communication tasks in foreign languages other than English.

List of courses

	Nature	CM	TD	TP	Crédits
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
French as a Foreign Language	Matière				
LSF - S7	Matière				

Spanish

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BA

Spanish

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BB

Chinese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BC

Italian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BD

Japanese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BE

Russian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BF

German

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BG

French as a Foreign Language

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01BH

LSF - S7

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9TM1A

Sports

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EK01C
- **Open to exchange students:** No

Presentation

Description

Physical Education & Sport courses are scheduled over 4 semesters consisting of 80 hours of face-to-face training maximum. They are organized by the INP Department of Physical Education and Sport (Département d'Éducation Physique et Sportive, DEPS-INP) which also proposes participation in numerous university tournaments and events. There is a dynamic student sports association which offers a wide range of activities throughout the school year.

Leadership & Management

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

Number of hours
21h

In brief

- **Ametys Code:** N7EK01D
- **Open to exchange students:** No

Presentation

Objectives

1. Build on personal professional project groundwork from L3 semesters 1 and 2;

2. Update & develop related documents, carry out research on the chosen industrial sector, measure needs & opportunities, & interview engineers from the network to discover more about their day-to-day professional activities;
3. Reflect on later career stages and on their selected paths and other options;
4. Present and defend their project to a jury composed of teacher-researchers, human resources experts and industrial partners;
5. Garner feedback from experienced professionals and extend their network.

Description

By the end of the module, students will have:
assembled and reflected on previous PPP groundwork & developed related artefacts to showcase their skills effectively;
conducted exploratory documentary & interview research in a chosen engineering sector to compare & contrast professional opportunities;
used specific PPP tools proposed;
given a formal PowerPoint presentation of a chosen career path and its options, matching a specific personal profile and industrial needs in a given sector;

produced accompanying professional artifacts (CV, letter etc.) integrating company partner recommendations & advice.

FLUID MECHANICS 4

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM01

List of courses

	Nature	CM	TD	TP	Crédits
Complex Fluids	Matière				
Boundary Layers, Jet and laminar wakes	Matière				

Complex Fluids

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 17,5
- **Ametys Code:** N7EM01A

Presentation

Objectives

Knowing and mastering the key concepts of Complex Fluids.

Description

1 / Introduction- examples of applications 5 major types of complex fluids: thixoptropic, antithixotropic, pseudoplastic, dilatant, threshhold Effect of the difference of normal stresses: Weissemberg effect, ... Examples, applications, relation with the microstructure, formulation of industrial fluids and environmental fluids. Notion of relaxation time, phase transition, glass transition, compatible and incompatible mixtures
2 / PhenomenologyThe mechanical analog models: Kelvin, Maxwell, Burger, ...Kelvin generalized, Maxwell generalized
3 / Entropic elasticity. Rubber elasticity, Langevin's equation
4 / Mechanics of complex fluids. Behavioral laws and momentum conservation equation: objectivity, Reiner-Rivlin fluids, generalized Newtonian fluids, pseudoplastic fluids (plug flow), Eulerian elasticity notion, corotational and convected Maxwell models (Oldroyd-B), single integral models (Lodge, Wagner, ..)
5 / Molecular models Rouse model (polymer in solution) Fractality and self - similar behavior - modeling6 / Experimental rheology. Rheometries plan-plan, cone-plan, Couette, capillary, elongational

Pre-requisites

Continuous medium mechanics

Meca Fluides 1

Boundary Layers, Jet and laminar wakes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM01B

Presentation

Objectives

Presentation of asymptotic calculation methods (perfect fluid, boundary layers) and analytical resolution of simple problems in laminar flow. Analysis of wall transfers (momentum, heat flow, mass transfer)

Description

Reminders about the perfect fluid flows.

Dynamic, massic and thermal laminar boundary layers

- Localization of viscous effects in real fluid flows with large Reynolds number: advection-diffusion report

- Characteristic parameters of the boundary layers: thicknesses, wall transfers

- Local equations of the isovolume dynamic boundary layer: Prandtl model

- detachments

- Integral equations and global balances in evolution isovolume: von Karman equations Methods and examples for calculating boundary layer flows

- Resolution of local equations

- Calculation by integral method: von Karman-Polhausen equations

- Examples of calculations: flat plate, impacting jet

Title Associated TP (s): Limit layer on flat plate at ENSICA

FLUID MECHANICS 5

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM02

List of courses

	Nature	CM	TD	TP	Crédits
Turbulent Flows Introduction	Matière				
History of Fluid Mechanics	Matière				

Turbulent Flows Introduction

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM02A

Presentation

Objectives

- Presentation of classical methods of treatment and resolution of turbulent flows
- Introduction of the concept of turbulent viscosity and the associated assumptions and limitations
- Application to cases of canonical turbulent flow (jet, boundary layer ...)
- Phenomenological introduction of turbulent field statistics (multi-point time statistics) and aspects of dispersion and mixing by turbulent flows
- Opening on the different numerical simulation strategies of turbulent flows.

Description

- 9 courses
- 6 TD
- 2 TP computer
- 2 experimental labs
- 1 exam

Introduction to turbulent flow
1- Introduction
2- derivation of Reynolds equations
3- Free shear flows (jets, wakes, layer of mixtures)
4- Wall flows (boundary layers, pipes)

5- Turbulent mixing and natural convection
6- Structure of the turbulence

Pre-requisites

- Basis on Mechanics of continuous media and fluid mechanics (notion of constraints, Navier-Stokes equations)
- Concepts of statistics and signal processing (moment, correlation, spectrum, distribution function)

History of Fluid Mechanics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9TUJN
- **Open to exchange students:** No

Presentation

Description

1 Fluid mechanics from Archimedes to Reynolds

2 Forces on an obstacle: drag, lift, boundary layer

3 Turbulence: channel hydraulics, effective viscosity,
mixing length, statistical mechanics, internationalization

4 Fluid mechanics in France in the 20th century:
aeronautics, fluid mechanics institutes

5 History of the Toulouse Institute of Electrical Engineering (ENSEEIHT)

SCIENTIFIC COMPUTING 2

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM04

Presentation

Objectives

Perform numerical simulations for fluid mechanics problems via:

- the use of Computational Fluid Dynamics codes

- developing numerical softwares solving 2 dimensional Partial Differential Equations.

Pre-requisites

- Notions in the numerical analysis of partial differential equations.

- Notions programming (python, C, fortran, etc)

- Notions regarding the finite volume method

List of courses

	Nature	CM	TD	TP	Crédits
Advanced use of CFD codes	Matière				
Numerical Methods for PDE	Matière				
Stochastic Processes	Matière				

Advanced use of CFD codes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM04A

Presentation

Objectives

Present the structure of a generalist fluid mechanics code. Interpret the results of the code by providing critical expertise based on the achievements of second year fluid mechanics courses

Description

Illustration of the second year fluid mechanics course.
Interpret and critique the results of the code on different classical examples: Turbulent flow in a tube, and mini-project on an advanced case

Pre-requisites

Knowledge in fluid mechanics

previous use of CFD codes is preferable

Numerical Methods for PDE

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM04B
- **Open to exchange students:** Yes

Presentation

Objectives

- Introduction to the methods of resolution of linear systems applied to numerical methods for solving a partial differential equation (PDE).

- From an existing code solving a 2D advection-diffusion PDE (language: Fortran 90, explicit scheme), modify it in order to use implicit scheme.

Description

Teaching (2 classes):

- Explicit/implicit scheme, finite-volume method

- Introduction to direct/iterative methods for solving linear systems

Project (8 classes):

- getting use to the explicit code

- writing of the implicit scheme

- implementation and exploitation of the implicit scheme

Pre-requisites

- Notions in the numerical analysis of partial differential equations.

- Notions programming (python, C, fortran, etc)

- Notions regarding the finite volume method

Useful info

Contacts

Responsable pédagogique

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Stochastic Processes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM04C
- **Open to exchange students:** No

Presentation

Objectives

The aim of the course is to introduce the concepts used to model processes in which physical quantities are random functions of time. This course focuses mainly on diffusion processes.

- Einstein's solution of Brownian motion
- Generalization using the Chapman-Kolmogorov equation based on transition probabilities.
- Introduction to the Langevin process
- Fokker-Planck equations

Description

The course is divided into two parts: a theoretical part (4 sessions) that introduces the various concepts, followed by a practical part (6 sessions) that corresponds to a digital project that students carry out in groups.

TRANSFERTS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM05

List of courses

	Nature	CM	TD	TP	Crédits
Heat and Mass Exchange	Matière				
Transfers in porous media	Matière				

Heat and Mass Exchange

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM05A

Presentation

Objectives

This course introduces the three main mechanisms of heat transfer (conduction, convection and radiation). The course focuses on basic methods to estimate heat flux and temperature magnitude in systems as well as industrial or natural. The program follows the book Fundamental of Heat and Mass Transfer, Bergman et al..

Description

1. Introduction : the three modes of heat transfer, energy balance, examples.
2. Heat conduction : steady-state conduction in 1 and 2 dimensions, transient conduction.
3. Convection : forced convection, external and internal flows, free convection, conservation equations, boundary layers and empirical method.
4. Radiation : radiation concept, black body, surface effects, radiation exchange between surfaces.
5. Experimental works : infrared thermography, heat conduction coefficient and thermal diffusivity measures.

Transfers in porous media

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 15.75
- **Ametys Code:** N7EM05B

Presentation

Objectives

The basics about porous media are presented.
The understanding of moisture displacements in porous media under the effect of gravity or capillarity is discussed. We will study the resolution of flow problems in a porous medium whether it is transient or permanent.
Ultimately, the student following this course will be able to model mass transport in porous media by having tackled the problem of upscaling. This teaching covers broad application areas: underground hydraulics, petroleum engineering, drying techniques, civil engineering, agriculture, etc.
It serves as a basis for 3rd year specialty courses in hydrology or multiphasic porous media.

Description

Description and characterization of the different physical structures most commonly encountered in porous media. Definition of parameters specific to their study.
Presentation of some methods for solving flows occurring in underground hydraulics (Darcy's law, free surface flows, non-permanent flows).
Mass transport in porous media: dispersion equation with illustration of solute transport, active or not, within a porous matrix.

Pre-requisites

Basic knowledge in fluid mechanics

MECHANICS 2

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM03

List of courses

	Nature	CM	TD	TP	Crédits
Wave dynamics	Matière				
Introduction to structure mechanics	Matière				

Wave dynamics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM03A

Presentation

Objectives

At the end of lectures and tutorials on the dynamics of strained string vibrations, sound waves, surface waves and elastic waves, students in this course will be able to:

- quickly produce the linearized version of a model,
- accurately illustrate the oscillations of the physical fields,
- quickly apply the method of solving the wave equation,
- generate with hindsight calculations of coefficients of reflection and transmission,
- generate without error the dispersion relation of the waves,
- systematically compare their phase and group speeds,
- explain the phenomenon of wave packets,
- describe qualitatively the impulse response of a medium.
- read and assimilate a significant part of the concepts and developments of a reference book on the subject, in English.

Course teaser

Click here to see the video

Description

Lectures and tutorials

The following chapters of the book of reference (wave motion) are discussed in the following order:

7. Formation and propagation of shock waves
1. Basic Concepts
2. Waves along a string with tension
3. Sound Waves
4. Linear surface waves
5. Waves in an elastic solid

The oral presentation will highlight the generality of the concepts studied and will be given an important place in understanding the calculations presented in the book in order to properly assimilate. Digital artwork will be developed.

Project on the serious game "Car Traffic"

- Link to the car traffic simulator
- Link to the associated pedagogical numerical resource

Objectives: At the end of the project on the dynamics of this road traffic model, the students of this course will be able to apply the method of the characteristics to calculate the evolution of a density of cars in the presence of small disturbances or important disturbances like the alternation of a traffic light.

Pre-requisites

Fluid mechanics skills in the first year of a Fluid Mechanics Department

Useful info

Contacts

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Introduction to structure mechanics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7EM03B
- **Open to exchange students:** No

Presentation

Objectives

Introduce the basic concepts for dealing with a structural mechanics problem. At the end of this course, students will be able to deal with the static and dynamic problems of a structure subjected to loading as well as the problems of buckling of a structure.

Description

-Geometry of the beams and introduction of the torsor.

-Normal effort.

-Moment of flexion.

- Shearing effort.

-Energy methods (Castigiano's theorem, Menabréa's theorem, fictitious load method, Maxwell-Betti's theorem).

-Modeling of the buckling of a structure.

-Dynamic structures (Rayleigh method, Ritz method, introduction to finite element method).

This teaching will be broken down into 8 courses and 10 tutorials.

Parcours Eau et Environement S8

ECTS
30 credits

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

In brief

- **Ametys Code:** M7V3KHEP

List of courses

	Nature	CM	TD	TP	Crédits
SOFT AND HUMAN SKILLS	UE				5 credits
Professional English 2.2 : Debates	Matière				
Second language	Choix				
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
french (as a foreign language)	Matière				
LSF - S8	Matière				
Sports	Matière				
Careers and Management - Sem.8	Choix				
Leadership	Matière				
Entrepreneurship	Matière				
Citizenship	Matière				
Managership-S8	Matière				
Choice of UE PROJECT MF2E S8	Choix				
Experimental Project	UE				5 credits
Experimental Project	Matière				
Numerical Project	UE				5 credits
Numerical Project	Matière				
Research project	UE				5 credits
Research project	Matière				
HYDRODYNAMICS AND STRUCTURES	UE				5 credits
Open channel flows	Matière				
TRANSFER IN POROUS MEDIA	UE				5 credits
Erosion and Solids Transport	Matière				
Eco-hydraulic	Matière				
CLIMATE PROJECT BASED LEARNING	UE				5 credits
Climate PBL	Matière				

SOFT AND HUMAN SKILLS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01
- **Open to exchange students:** Yes

List of courses

	Nature	CM	TD	TP	Crédits
Professional English 2.2 : Debates	Matière				
Second language	Choix				
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
french (as a foreign language)	Matière				
LSF - S8	Matière				
Sports	Matière				
Careers and Management - Sem.8	Choix				
Leadership	Matière				
Entrepreneurship	Matière				
Citizenship	Matière				
Managership-S8	Matière				

Professional English 2.2 : Debates

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 21
- **Ametys Code:** N8EK01A

Presentation

Objectives

Perform key oral and written workplace tasks in English.

Description

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

Pre-requisites

None

Second language

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01B
- **Open to exchange students:** No

Presentation

Description

Develop professional communication skills by performing common written and oral communication tasks in foreign languages other than English.

List of courses

	Nature	CM	TD	TP	Crédits
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
french (as a foreign language)	Matière				
LSF - S8	Matière				

Spanish

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BA

Spanish

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BB

Chinese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BC

Italian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BD

Japanese

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BE

Russian

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BF

German

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BG

french (as a foreign language)

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01BH

LSF - S8

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9V0GX

Sports

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EK01C
- **Open to exchange students:** No

Presentation

Description

Physical education and sports courses are spread over four semesters and include a maximum of 80 hours of classroom training. They are organized by the INP's Department of Physical Education and Sports (Département d'Éducation Physique et Sportive, DEPS-INP), which also offers participation in numerous university tournaments and events. There is a dynamic student sports association that offers a wide range of activities throughout the academic year.

Careers and Management - Sem.8

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9V5XT

List of courses

	Nature	CM	TD	TP	Crédits
Leadership	Matière				
Entrepreneurship	Matière				
Citizenship	Matière				
Managership-S8	Matière				

Leadership

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9V63Z
- **Open to exchange students:** No

Presentation

Objectives

M1 Leadership 1: Project Management

1. Understand the principles of project management.
2. Develop skills in project planning and execution.
3. Analyze and compare project management approaches.
4. Apply project management techniques in case studies.
5. Facilitate effective meetings with project clients and stakeholders.
6. Use tools for project planning and communication.

M1 Leadership 1: Conflict Management

1. Understand the root causes of conflict in the workplace.
2. Develop negotiation skills.
3. Analyze and compare conflict management approaches.
4. Apply different techniques to resolve conflicts with colleagues.

M1 Leadership 2 : Business Game in Managerial Accounting

1. Decode and analyze summary accounting documents
2. Understand how to interpret commercial study documents (market shares, seasonal coefficients)

3. Calculate costs and margins, develop production plans, commercial forecasts, and profitability projections, considering mainly commercial strategic choices
4. Organize themselves in groups, follow instructions, and apply negotiation techniques.

Description

M1 Leadership 1: Project Management

By the end of the module, students will have :
effectively planned and executed projects using traditional methods, focusing on aspects such as Gantt charts, critical path analysis, and resource allocation.
analyzed and compared basic project management approaches with other methodologies, particularly understanding the context in which project management is most effective.
applied basic project management techniques to real-world or simulated case studies.
efficiently conducted and facilitated meetings with project clients and stakeholders, focusing on techniques to maximize time and cost efficiency.

M1 Leadership 1: Conflict Management

Session 1: Introduction to conflict management
Session 2: Process Communication Management
Session 3: Negotiations
Session 4: Conflicts across cultures 1
Session 5: Conflicts across cultures 2
Session 6: Role Plays

M1 Leadership 2 : Business Game in Managerial Accounting

By the end of the module, students will have :

familiarized themselves with a number of key business concepts (recruitment/HR, management/finance, marketing/communication, etc.);
worked as team players and leaders to make complex strategic business decisions respecting constraints, deadlines, objectives, etc.;
measured the impact of their decisions on company performance.

Entrepreneurship

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9V6A1

Citizenship

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9V6FO

Managership-S8

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9V6M7

Choice of UE PROJECT MF2E S8

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EMPRJ

List of courses

	Nature	CM	TD	TP	Crédits
Experimental Project	UE				5 credits
Experimental Project	Matière				
Numerical Project	UE				5 credits
Numerical Project	Matière				
Research project	UE				5 credits
Research project	Matière				

Experimental Project

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM01

Presentation

Objectives

The objective of this teaching unit is to implement a particular methodology (numerical or experimental) to carry out a scientific project.

The skills developed are:

- Physical analysis of the problem to be treated
- Choosing an appropriate methodology
- Implementation of this methodology (existing tools or tools to develop)
- Results analysis

List of courses

	Nature	CM	TD	TP	Crédits
Experimental Project	Matière				

Experimental Project

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM01A

Presentation

Objectives

Give the students the opportunity to deepen their knowledge by carrying out a project in a small group under the guidance of an educational tutor. Allow students to acquire autonomy and sense of initiative. Introduce students to project management and teamwork.

Description

The work program depends on the subject chosen in consultation between the group of students and the tutor. It focuses on the illustration, mostly experimental, and the better understanding of physical phenomena addressed in the teachings of the department.

Numerical Project

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM02

Presentation

Objectives

- study a physical problem using or developing numerical tools

- manage a group project in semi-autonomy

Pre-requisites

None

List of courses

	Nature	CM	TD	TP	Crédits
Numerical Project	Matière				

Numerical Project

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM02A

Presentation

Objectives

The objective of this course (in the form of a project) is to study in small groups an environmental phenomenon of your choice based on numerical simulation tools. To do this, you will have the choice of the subject and the methodology, with two possible strong orientations: starting from an existing code / numerical simulation software to study a particular phenomenon or directly developing a numerical simulation code (solving the equations of St Venant for example).

From your choice, you will realize your group project in autonomy, with the support of the supervisors to guide you in your approach.

The objectives of this course are multiple, it will be useful both from a numerical point of view to develop your skills of coding, use and understanding of the codes used in environment, to deepen and better understand a subject in environment, and also to develop your autonomy and project management skills.

The rendering will be in the form of a website, followed by an oral presentation to share your project with the rest of the class.

Description

- Project management: autonomy, group organization, time management ...

- Coding / use of software
- Deepening of a theme of personal interest
- Writing a report, ability to analyze, critique and summarize

Research project

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM11

List of courses

	Nature	CM	TD	TP	Crédits
Research project	Matière				

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

TOULOUSE INP N7

Research project

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM11A
- **Open to exchange students:** No

Presentation

Description

The research course will be introduced for 2nd year students at the start of the 2021 academic year. It runs from February to June and gives students the opportunity to work closely with a researcher and/or doctoral/post-doctoral student at IMFT. If you're not sure whether you're ready or willing to do a laboratory internship, a 3rd year research master's degree or even a thesis, this course is for you.

It will replace either the Personal Initiative Project or the Digital Project in the second semester.

Students can work in groups of 3 or 4 on the same subject.

Each group will be asked to prepare an A0 poster in English. Posters can be printed at the N7 fablab and must be posted on the grids by 2pm. Each group must present its work in English for around ten minutes and answer questions. The format is that of a Congress poster session, with several people taking turns to see the posters. Each group will have to make several presentations.

HYDRODYNAMICS AND STRUCTURES

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N8EM03

Presentation

Objectives

This UE addresses all the notions of hydrodynamics in environment necessary to a hydraulic engineer:

- the theoretical bases are given in the course of Free Surface Hydraulics,
- the 1D and 2D modeling project allows students to familiarize themselves with standard 1D and 2D free-surface flow simulation software in practical study-office type cases,
- numerical methods for free-surface flows make the link between theory and modeling by emphasizing the good conditions of use of software,
- the experimental project proposes direct applications of theoretical and numerical bases,
- the Canal Control and Irrigation course applies all of these concepts to the operational management of irrigation canals.

List of courses

	Nature	CM	TD	TP	Crédits
Open channel flows	Matière				

Open channel flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9VDFU
- **Open to exchange students:** No

Presentation

Objectives

- Model free-surface flows using Saint Venant theory
- Use industrial codes to describe free-surface flows in 1D and 2D on concrete cases.

Description

The Free Surface Hydraulics course is divided into five sections:

HSL course: lectures, tutorials and written exam

Experimental project: experimental projects illustrating the concepts of the theory course

Digital project: digital TPs illustrating the concepts of the theory course

1D and 2D modeling: 1D and 2D modeling using the HEC-RAS code, case study

(Channel control)

TRANSFER IN POROUS MEDIA

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N8EM04

Presentation

Objectives

This UE consists of an introduction to the transfer processes in natural environments, characterized here by the sedimentary (erosion and sediment transport) and ecological (eco-hydraulic) aspects related to watercourses, as well as by the hydrology of sub-rivers. surface (hydraulic in porous media).

List of courses

	Nature	CM	TD	TP	Crédits
Erosion and Solids Transport	Matière				
Eco-hydraulic	Matière				

Erosion and Solids Transport

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM04A

Presentation

Objectives

At the end of the course students will need to know :

- Identify the issues associated with sediment transport in rivers.
- Define dimensionless numbers associated with sediment transport and associated modes of transport.
- Determine the threshold of movement of a watercourse from the granulometry, the water level and the slope of the watercourse.
- Explain the mechanisms associated with the equilibrium slope of a watercourse.
- Plan the evolution of a watercourse in model situations from the mechanisms associated with the balance of a watercourse.
- Plan the evolution of a watercourse in concrete situations from the mechanisms associated with the balance of a watercourse.
- Describe the different types of watercourse and their link with their environment (mountain, plain, ..).
- Understand technical documents on the transport of sediments in rivers.
- Defend a watercourse development project by arguing on a scientific basis.
- Interact and convince an audience.
- Evaluate the work and understanding of other students.

Description

The objective of the course is to give you a first approach to sediment transport, more specifically focused on sediment transport in rivers.

Starting from the mechanisms at the particle scale, we will introduce the dimensionless sediment transport numbers to identify the main parameters and define the different transport regimes. The role of dimensionless numbers and their implications will be illustrated through concrete applications. Subsequently, we will introduce the concept of power in relation to the equilibrium slope of the watercourse. This will allow us to analyze a number of field situations and to understand the basic mechanisms of sediment transport. From there, we will also study the different forms of watercourse, from the mountain to the plain.

The rest of the course will be dedicated to the study and analysis of concrete documents written by actors from the field (engineering office, RTM, river unions ...), which will then be explained and defended orally before other students.

The teaching will be largely based on student participation, through activities, reflections and group work.

Pre-requisites

- Fluid mechanics: forces on a particle in a flow, free surface hydraulics (flow regime, general knowledge), power of a flow.
- Curiosity
- Motivation
- Participation

Eco-hydraulic

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM04C
- **Open to exchange students:** No

Presentation

Description

Course outline

A- Introduction

- Presentation of the OFB and the ecohydraulics division
- The water cycle
- Flow and hydrological regimes

B- Habitat structuring

- Velocity gradients and solid transport
- Longitudinal structuring
- Transverse structuring
- Vertical structuring

C- Biological organization: habitat-fish relationships

- Community structure: upstream-downstream zonation
- Community structure: lateral distribution
- Community structure: vertical distribution
- Notions of habitat preference

D- Importance of ecological continuity

- Definitions
- Fish mobility requirements
- Ecological continuity in French legislation

CLIMATE PROJECT BASED LEARNING

ECTS
5 credits

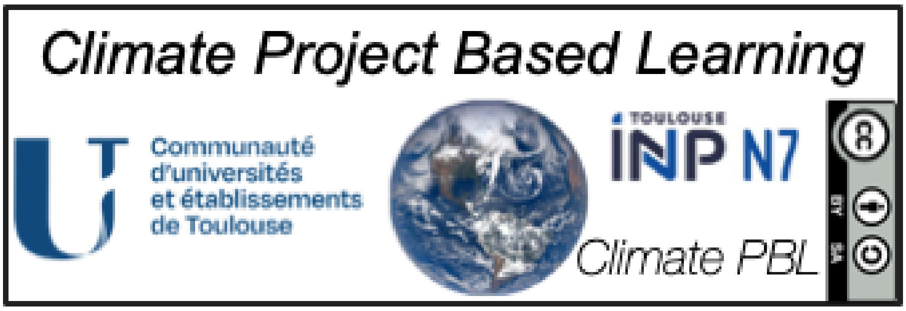
Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM05
- **Open to exchange students:** No

Presentation

Description



List of courses

	Nature	CM	TD	TP	Crédits
Climate PBL	Matière				

Climate PBL

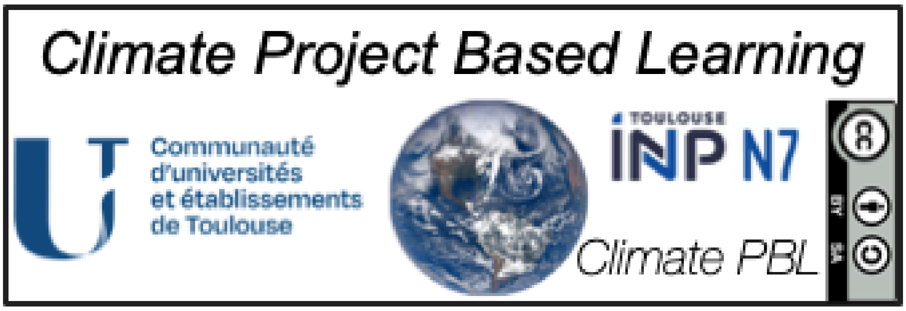
Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM05E
- **Open to exchange students:** No

Presentation

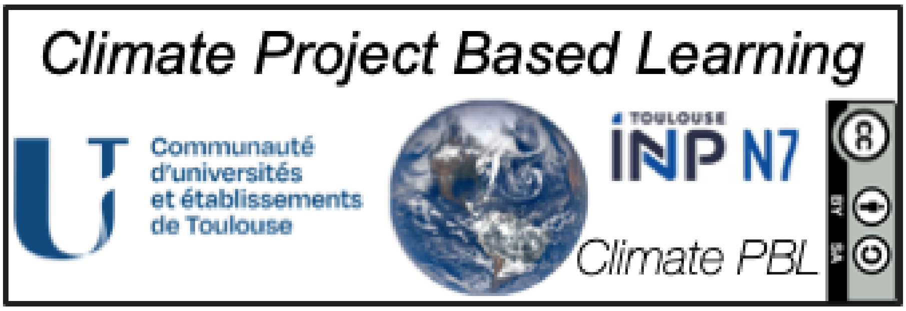
Objectives



At the end of the sixteen 1h45 sessions of the Climate PBL, engineering students will be able to:

- Describe the predominant phenomena of the water cycle and atmospheric circulation
- Explain the mechanisms responsible for climate change and its impacts
- Organize a sequence of processes using conceptual diagrams
- Integrate multiple pieces of information from scientific literature
- Select key facts to explain complex scientific concepts
- Generate educational resources that can be easily used by other scientists

Description



The Table below presents the program of the 16 sessions of the "Climate PBL". The first two sessions are grouped into a half-day for an introduction to the course, followed by training in the animation of the Climate Fresk. The last two sessions, also grouped into half a day, are devoted to "reverse lectures", during which three groups of students present a summary of the "Active Multimedia Conference" (AMC) they have constructed. Between these two half-days, the sessions combine lectures by teachers and group work workshops under the supervision of these experts.

Slots		**Sequencing of sessions**	**C**	**PD**	**OL**	**OP**	**HR**	**MB**	**DA**	**OT**	**Total**
TD	1	Presentation of the Climate PBL and "Climate Fresk" facilitation training							1	1	2
TD	2								1	1	2
CM	3	Additional greenhouse effect							1	1	2
CM	4	Disruption of the water cycle					1			1	2
CM	5	Flooding			1						1
CM	6	Freshwater resources	1								1
CM	7	Cyclones				1					1
CM	8	Carbon Cycle (three cards		1						1	2

		in the Fresk)									
CM	9	Aerosols		1					*1*		2
CM	10	Air Temperature Rise							1	*1*	2
CM	11	Ice melting (three cards in the Fresk)			1				*1*		2
CM	12	Rising water temperature			1				*1*		2
CM	13	Extreme climate events						1	*1*		2
CM	14	Floods	1				1		*1*		3
TD	15	Defences of the "Multimedia Pedagogical Conferences" projects and mini-fresks					1			1	2
TD	16						1			1	2
		TOTAL	2	2	3	1	4	1	9	8	**30**

Parcours Fluides et Procédés S8

ECTS
30 credits

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

In brief

- **Ametys Code:** M7V3LD9R
- **Open to exchange students:** No

List of courses

	Nature	CM	TD	TP	Crédits
SOFT AND HUMAN SKILLS	UE				5 credits
Professional English 2.2 : Debates	Matière				
Second language	Choix				
Spanish	Matière				
Spanish	Matière				
Chinese	Matière				
Italian	Matière				
Japanese	Matière				
Russian	Matière				
German	Matière				
french (as a foreign language)	Matière				
LSF - S8	Matière				
Sports	Matière				
Careers and Management - Sem.8	Choix				
Leadership	Matière				
Entrepreneurship	Matière				
Citizenship	Matière				
Managership-S8	Matière				
Choice of UE PROJECT MF2E S8	Choix				
Experimental Project	UE				5 credits
Experimental Project	Matière				
Numerical Project	UE				5 credits
Numerical Project	Matière				
Research project	UE				5 credits
Research project	Matière				
AERODYNAMICS	UE				5 credits
Compressible Flows	Matière				
Gas turbomachines	Matière				
INDUSTRIAL SYSTEMS	UE				5 credits
Physical Analysis of Industrial Processes	Matière				
Thermodynamics of Machines	Matière				
Simulation Hydrodynamique et Transferts	Matière				
MULTI-SCALE PROCESSES	UE				5 credits
Vibration under flow	Matière				
Microfluidic Introduction	Matière				
TEDT : Turbulent Dispersion	Matière				

AERODYNAMICS

ECTS
5 credits

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

In brief

- **Ametys Code:** N8EM06
- **Open to exchange students:** No

List of courses

	Nature	CM	TD	TP	Crédits
Compressible Flows	Matière				
Gas turbomachines	Matière				

Compressible Flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM06A

Presentation

Objectives

To be able to calculate flows of compressible fluids 1D and 2D

Description

I. Introduction and equation

II. Monodimensional flows

III. Shocks

IV. Theory of small disturbances

V. Characteristic method

Gas turbomachines

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM06B

Presentation

Objectives

This course is designed to familiarize the student with the operation of gas turbine engines (turbines, compressors, fans) and their dimensioning (drawing of blades, similarity ...)

Description

- Conservation of energy and momentum

- Operation of turbomachines (axial machines, radial machines)

- The centrifugal compressor

- The axial turbine

- Similarity and returns

- Efforts on the blades

INDUSTRIAL SYSTEMS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM09

List of courses

	Nature	CM	TD	TP	Crédits
Physical Analysis of Industrial Processes	Matière				
Thermodynamics of Machines	Matière				
Simulation Hydrodynamique et Transferts	Matière				

Physical Analysis of Industrial Processes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM07B

Presentation

Objectives

The objective of this course is to take an interest in the physical phenomena involved in processes of energy or matter transformation. It details the industrial applications concerned, the physical phenomena that occur there and the possible coupling with chemical reactions.

Description

Industrial Issues and Scientific Competence

Gas-liquid transfer in monoliths Description and sizing of columns (distillation - extraction)

Stagnant film theory and reactive transfer

Design office: micro-macro analysis

Thermodynamics of Machines

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM07C

Presentation

Objectives

The purpose of this course is to apply the 1st year thermodynamics course to non-condensable gas cycle machines.

Description

The first lesson is dedicated to thermodynamic reminders of open machines. The thermodynamics of machines is applied to the study of gas turbines and turbojets (3 sessions). The optimization of the machine cycles is treated with the ThermOptim software (6 sessions). This software will also be used in the 3rd year in the "Thermal Machines" module (3A / MOST)

Simulation Hydrodynamique et Transferts

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM09A
- **Open to exchange students:** No

Presentation

Description

- Session 1: Introduction and first examples
- Session 2: Natural convection in a square
- Sessions 3 to 5: Mass transfer around a clean or contaminated rising bubble (Project - 3*2h)
- Session 3: modelling of the hydrodynamics of the rising bubble (cases of both a clean and a contaminated bubble)
- Session 4: Coupling with mass transfer from the gas to the liquid phase
- Session 5: Coupling of mass transfer with a chemical reaction in the liquid phase

MULTI-SCALE PROCESSES

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM10

List of courses

	Nature	CM	TD	TP	Crédits
Vibration under flow	Matière				
Microfluidic Introduction	Matière				
TEDT : Turbulent Dispersion	Matière				

Vibration under flow

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM06C

Presentation

Objectives

- Know how to identify the mechanism causing a vibration problem of a structure placed in a flow.
- Knowing how to choose the acquisition and processing parameters to identify the modes of an aeroelastic system by spectral analysis.

Description

I. Physics of the interaction

- Examples and industrial context, classification by dimensional analysis, aerodynamic complements.
- Vortex-induced vibration, lock-in
- Stability analysis, damping and added stiffness (galloping, divergence)
- Aeroelastic transients, dynamic stall, hereditary damping
- State formalism, modal analysis, antisymmetric stiffness coupling (flutter flexion-torsion of a wing).

II. Experimental identification

- Periodic estimation of Welch, statistical properties
- Method of identification of fluidelastic coupling (direct or indirect)
- Filtering relations (Wiener-Lee), consistency function
- Practical application (TP) to spectral and correlation analysis "real time" of a flexible structure in a turbulent flow. Identification of a Movement Induced Vibration (MIV) coupling

Microfluidic Introduction

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 12,5
- **Ametys Code:** N8EM07A

Presentation

Objectives

Present important and useful concepts to microfluidics focusing on small scale hydrodynamics and the effect of surface forces on Stokes flows.

Description

1. Introduction: MEMS to microfluidics
2. Physics at the micrometric scale
3. Hydrodynamics of microfluidic systems
4. Interfacial hydrodynamics
5. BE: Microfabrication - Applications

Pre-requisites

Meca Fluides 1 et 2

TEDT : Turbulent Dispersion

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8EM10A
- **Open to exchange students:** No

Presentation

Description

The aim of the course is to model the transport of a 'passive scalar' or 'material particles' injected into a turbulent (a minimally random) flow.

The aim is to answer the following questions:

- How to characterize the mixture?
- How can we calculate the transport of these fluid or particle constituents?

Science de l'Eau et Environnement (SEE)

ECTS
30 credits

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

In brief

- **Ametys Code:** M4SKFGV6
- **Open to exchange students:** No

List of courses

	Nature	CM	TD	TP	Crédits
Soft and Human Skills MF2E S9	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				
Choix de Spécialité-SEE	Choix				
Spécialité-SEE	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				
Spécialité-SEE-Aéro	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				
Spécialité-SEE-BD	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				
Spécialité-SEE-Aéro-BD	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				

Soft and Human Skills MF2E S9

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK04

List of courses

	Nature	CM	TD	TP	Crédits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				

Professional English-LV1-Semestre 9

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01A
- **Open to exchange students:** No

Presentation

Description

Develop your professional communication skills by performing common written and oral communication tasks in English.

List of courses

	Nature	CM	TD	TP	Crédits
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				

Anglais Scientifique

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01AA
- **Open to exchange students:** No

Presentation

Description

Specific teaching to improve scientific English.

Choix 2 Anglais Professionnel - 3A

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01AX

List of courses

	Nature	CM	TD	TP	Crédits
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				

Anglais Clinique

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01AB
- **Open to exchange students:** No

Presentation

Description

Specific teaching to reach level B2.

Anglais de Cambridge ou Projet

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01AC
- **Open to exchange students:** No

Presentation

Description

Specific teaching to prepare for the Cambridge Proficiency exam or a project.

CHOIX 2 sur 3 SHS MF2E S9

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK04X1

List of courses

	Nature	CM	TD	TP	Crédits
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				

Hydraulic operating control

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01BA

Presentation

Objectives

Give future engineers the notions and tools to be operational in project management, here applied to hydraulic engineering.

Description

- Project manager & company manager".
Role of each stakeholder. Regulatory files: authorization file, nomenclature of the law on water, relationship with the services of the Administration (DREAL, DDT, AFB ...). Schedule of operation.

- "The standardized missions of the project manager".
APS, AVP, PRO, DCE, VISA, DET, OPR.

- "Business Consultation "
Constitution of technical documents for consultation (CCTP, BP, DQE). Presentation of the repositories (Eurocodes, fascicles, standards, GTR).

Controversies in a world in transition

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01BB
- **Open to exchange students:** No

Presentation

Objectives

Helping to understand and communicate on social issues and controversies

Description

Session 1: “Defining the subject”
Defining the subject and the final rendering. Students work independently on their final project. Occasional meetings to interact with the project team possible.

Session 2: “Documentary research” (Isabelle Perez, biblioN7)
What tools did the students use to document their chosen subject? Where do they come from? Are they trustworthy?

Sessions 3 and 4: “Controversy” (François Purseigle, Antoine Doré, Geneviève Nguyen, ENSAT)
What is a “controversial” subject? How do controversies between science, technology, society and innovation arise? Possible extension to economic considerations / sustainable development, etc.

Session 5: “Testimonials from working engineers confronted with the issues under study” (external speakers)
Testimonials and discussions organized by students.

RSE (MF2E)

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01BC
- **Open to exchange students:** No

Presentation

Objectives

- Present corporate social responsibility: definitions of the concept of sustainable development (SD) and its implementation using the guidelines of standard 26000.

- Tutorial on a company's CSR report to identify the SD issues taken into account by the chosen company, and its consistency with the company's potential impacts.

Description

The aims of the course :
- introduce you to the challenges of CSR for your future profession
- understand the role of CSR in organizational strategies and how its challenges are transforming organizations and their business models
- understand how CSR and its challenges will impact your way of working and managing
- identify stakeholders' expectations in terms of CSR and related issues: climate change, employee disengagement, the search for meaning, biodiversity, management, marketing and responsible communications
- know how to identify what is genuine CSR and what is window-dressing or greenwashing
- understand how a CSR strategy is implemented and better understand your future contribution
- take the right stance within the company, knowing what you're really talking about

- be able to ask the right questions at a job interview to prepare yourself properly

CHOIX 1 sur 2 SHS MF2E S9

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK04X2

List of courses

	Nature	CM	TD	TP	Crédits
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				

Entrepreneurship Project

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK01E
- **Open to exchange students:** No

Presentation

Description

Project aimed at developing entrepreneurial skills.

Corporate Project and social responsability

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EK04A
- **Open to exchange students:** No

Presentation

Description

Preparation of a project in collaboration with an industrial partner (definition of the problem, specifications, tools, schedule, project team).

Choix de Spécialité-SEE

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

In brief

- **Ametys Code:** N9EMBX

List of courses

	Nature	CM	TD	TP	Crédits
Spécialité-SEE	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				
Spécialité-SEE-Aéro	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				
Spécialité-SEE-BD	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				
Spécialité-SEE-Aéro-BD	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

Spécialité-SEE

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

In brief

- **Ametys Code:** N9EMBX1

List of courses

	Nature	CM	TD	TP	Crédits
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				

ENVIRONMENTAL FLOWS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N9EM06

Presentation

Pre-requisites

- Basis on Dynamics Flows
- Basis on free surface water flows

List of courses

	Nature	CM	TD	TP	Crédits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				

Atmospheric boundary layer

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM06A
- **Open to exchange students:** No

Presentation

Objectives

- Become familiar with the basic concepts used to describe and model the atmospheric boundary layer.
- Be able to extract the essential elements from the reading of scientific documents with a view to practical applications.
- Master the basic analytical developments required for a physical understanding of the phenomena studied.
- Take ownership of the subject by carrying out projects.

Description

Pedagogical principles:

- Self-study from a corpus of resources
- Project work with homework and BE
- Link between knowledge and business applications
- Three main reading areas:
- Boundary layer in the neutral case: Ekmann spiral, logarithmic law
- Thermal waves and instabilities: relief waves, convection
- Turbulence modeling: TKE closures, Monin-Obukov

Project-based teaching:

- A document synthesis based on two articles
- A calculation code to be developed with production of results

- A written report combining knowledge and case studies

Pre-requisites

- Thermodynamic Basis
- Mechanic Flows Basis

Coastal Hydrodynamics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM06B
- **Open to exchange students:** No

Presentation

Objectives

- Highlight the specific features of the coastal environment
- Analyze the physical processes involved
- Propose models for the main phenomena
- Implement some simple models

Description

Course format :

- Project-based assessment.
- Lesson / Tutorial

Transport and Mixing

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM06C
- **Open to exchange students:** No

Presentation

Objectives

Introduction to the physical processes involved in the transport and mixing of substances, whether of anthropogenic origin or not, in environmental situations. It also presents some of the methods used to model the evolution of substances released into the natural environment.

INSTALLATION AND WORKS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM10

List of courses

	Nature	CM	TD	TP	Crédits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				

Soil mechanics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 17,5
- **Ametys Code:** N9EM10A

Presentation

Objectives

Obtain the basic notions of soil mechanics in order to be able to interact with geotechnicians.

Description

-What is a floor?
- soil classification
-water in the soil
- soil resistance
- in-lab and in-situ recognition

Engineering of hydraulic works

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 17,5
- **Ametys Code:** N9EM10B

Presentation

Objectives

To show how to use the knowledge acquired in the 3 years for the design and realization of facilities hydraulic and hydroelectric.

Description

The hydrology of a development, water intake, intake and discharge works, turbines and available power, environmental impacts and their reduction measures. Regulations to apply.

Impacts of industrial developments on the environment

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 8,75
- **Ametys Code:** N9EM10C

Presentation

Objectives

The aim of this environment module is to make engineering students aware of the need to take environmental protection into account during their future professional activities.

Description

1/ Hydraulic developments - environmental impact studies - soft development of the watercourse - water living environment

2/ Environment and business - environment-business plans - conventional waste and industrial

3/ Air and soil pollution

Risk and Prevention

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 8,75
- **Ametys Code:** N9EM10D

Presentation

Objectives

To make students aware of the notions of risk in industrial and environmental contexts.

Presentation of analysis methods.

Description

To make students aware of the notions of risk in industrial and environmental contexts.

Presentation of analysis methods.

Spécialité-SEE-Aéro

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

In brief

- **Ametys Code:** N9EMBX2

List of courses

	Nature	CM	TD	TP	Crédits
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				

APPLICATION TO AERODYNAMICS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM02

List of courses

	Nature	CM	TD	TP	Crédits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				

Aérodynamique

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M545MLHV
- **Open to exchange students:** No

Presentation

Objectives

Introduce the main physical concepts and mathematical tools for dealing with incompressible and compressible aerodynamic problems. At the end of this course, students should be able to formulate and apply aerodynamic models, and predict the forces applied to a wing and its performance. They should also be aware of the limitations of theoretical models.

Description

-General introduction, terminology and nomenclature.

-Understanding aircraft lift mechanisms.

Pre-requisites

"Basic fluid mechanics

"Thermodynamics basics

Aéroacoustique

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M545MLND

Fluid Structure Interaction

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM02C
- **Open to exchange students:** No

Presentation

Objectives

Fluid-structure interaction (FSI) phenomena can occur whenever a fluid comes into contact with a solid. The interactions likely to occur in this case are crucial in fields such as aeronautics, civil engineering, bio-mechanics, the nuclear industry, renewable energies and so on. Understanding these phenomena through modeling and simulation is therefore essential for fluid mechanics engineers.

This course aims to introduce the basic concepts associated with modeling and numerical simulation of fluid-structure interactions.

Description

-General formalism, dimensional analysis and classification of IFS problems.

Review of the main aeroelastic phenomena and their modeling (buffeting, flutter, galloping, static divergence, vortex-induced vibration (VIV)).

-Main IFS simulation methods.

Vortex-induced vibrations (VIV), frequency lock phenomenon: OpenFoam simulation

. -Immersed boundary method: further study in numerical simulation.

Spécialité-SEE-BD

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

In brief

- **Ametys Code:** N9EMBX3

List of courses

	Nature	CM	TD	TP	Crédits
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

BIG DATA AND GEOSCIENCES

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM08

List of courses

	Nature	CM	TD	TP	Crédits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

Mathematical methods for exploiting data

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM08A

Presentation

Objectives

Illustrate different mathematical methods for analyzing and using data in geoscience

Description

Part 1: Uncertainty Quantification
Part 2: Ensemble Methods for Data Assimilation

Useful info

Contacts

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Responsable pédagogique

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Using artificial intelligence for forecasting

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM08B

Presentation

Objectives

Illustrate different possible uses of artificial intelligence methods for forecasting in geosciences

Description

Part 1: Machine learning for forecasting
Part 2: Neural networks for classification in geoscience

Spécialité-SEE-Aéro-BD

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

In brief

- **Ametys Code:** N9EMBX4

List of courses

	Nature	CM	TD	TP	Crédits
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

HYDROLOGY

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM09

List of courses

	Nature	CM	TD	TP	Crédits
The Hydrology of Transfers	Matière				
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière				

The Hydrology of Transfers

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM09D
- **Open to exchange students:** No

Presentation

Description

Course outline :

- Flow in porous media

- Single-phase

- Multiphase flows

- Mass transfer in porous media

- Local equilibrium approaches

- Non-local equilibrium approaches

- Project

Pre-requisites

None

Hydrologie Approfondie : Bassin versant et Mil. Urb. (HABAMU)

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N9EM09E

Presentation

Objectives

Étude de la façon dont l'eau s'écoule en surface et en subsurface, ainsi que de la manière dont l'activité humaine peut influencer les conditions d'écoulement

Description

- Présentation du "grand" cycle de l'eau (hydrologie des bassins versants)

- Interception
- Fonte des neiges
- Évapotranspiration
- Infiltration
- Réponse hydrologique
- Ruissellement de surface et chemins de l'eau

- Présentation du "petit" cycle de l'eau (systèmes urbains)
- Questions relatives à la collecte et à l'analyse des données
- Mise en œuvre d'un modèle hydrologique

- Apprentissage basé sur la théorie et les exercices

Useful info

Contacts

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ADVANCED HYDRAULIC MODELING

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM11

List of courses

	Nature	CM	TD	TP	Crédits
Geographic Information System	Matière				
Advanced Free Surface Flow Modelling	Matière				
Sediment Transport and Morphodynamics	Matière				
Environmental numerical codes	Matière				

Geographic Information System

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 14 de TD
- **Ametys Code:** N9EM11A

Presentation

Objectives

These courses and tutorials are designed to introduce students to the principles of the Systems Information Geographic and their use.

Description

- Course: "Introduction to GIS
This course explains the fundamental principles of Geographic Information Systems. Course Outline:

Definition of a GIS, the components of a GIS (data, methods, human resources, etc.), the use of GIS and the use of GIS in the development of a GIS. and hardware), main functionalities, data representation mode (raster, vector),data structuring (storage models), repositories and cartographic projections (geoid, ellipsoid and geodetic systems), georeferencing. The different notions are illustrated in the tutorial framework.

Course: "Relief representation and digital terrain model".
This course provides an overview of the cartographic methods used to represent relief and exposes the theoretical basis for creating and manipulating digital terrain models (MNT). The concepts seen during the course are applied in the framework of tutorials.Course outline: Representation of the relief on a map (definition, side points, contour lines, etc.), special figures, illumination and fading, hypsometric tints). General characteristics of DTM (definition, mode of representation, principles of elaboration). Data

sources for the construction of MNT. Interpolation methods: global interpolation method (area of trend), local interpolation methods (moving average,inverse distance weighting, overview of kriging). Information derived from DTMs: slope and orientation, flow direction (method D4 and D8), calculation of drained surfaces, extraction of watersheds and network hydrographic, topological description of the hydrographic network.

Contents of the TSTs :
Introduction to ArcGIS software (and Spatial Analyst and 3D analyst extensions) and Idrisi software.
1) Introduction to ArcGIS software functionalities
2) Georeferencing of a topographic map (Idrisi)
3) Creation and manipulation of DTM - spatial analysis in raster mode (ArcGIS)
4) Network management
5) Modelling and assessment of soil sensitivity to erosion at the regional scale in France (ArcGIS)

Advanced Free Surface Flow Modelling

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N9EM11B

Presentation

Objectives

Use advanced 1D and 2D free surface flow modeling software, taking into account the following accounts for sediment and pollutant transport

Description

- use of the software for solving the Saint-Venant equations 1D/2D HECRAS, TELEMAC

- use of sediment transport modules HECHMS, SISYPHE

- use of associated pre- and post-processing software (ArcGIS, BlueKenue, Fudaa, Paraview)

Sediment Transport and Morphodynamics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 17,5
- **Ametys Code:** N9EM11C

Presentation

Objectives

Introduction to the physical processes of sediment transport by flows and methods estimating sedimentary fluxes and the resulting changes in the bottom.

Description

I. Geomorphology of coastlines and rivers
II. Local processes and morphodynamic models
III. Sediment properties
IV. Setting in motion
V. Modeling of Carriage Transport
VI. Transport modeling by suspension
VII. Multi-phase modelling approaches

Environmental numerical codes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM11D
- **Open to exchange students:** No

Presentation

Objectives

From a list of proposed problems, apply the scientific approach to the use of modeling tools specific to the themes introduced in the Environmental Fluid Mechanics courses given as part of the “Environmental Flows” U.E. of the Water and Environmental Sciences option (Aerosols, Atmospheric Boundary Layer, Coastal Hydrodynamics, Transport and Mixing, Sedimentary Transport and Morphodynamics).

Models on offer include: Fluent/Starccm+ codes (interface tracking modules, particle tracking, variable density fluids, etc.), specific modules from the Telemac suite (Artemis, Tomawak, Sysiphe, passive floats/tracers), Hysplit atmospheric dispersion code, etc.

Description

10 classroom sessions using aerodynamic and environmental codes such as Fluent, StarCd, Cormix, Comsol or others. Creation of a website presenting the work carried out.

TRANSITION AND RENEWABLE ENERGIES

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM12

List of courses

	Nature	CM	TD	TP	Crédits
Energy transition and renewable energies	Matière				

Energy transition and renewable energies

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM12A
- **Open to exchange students:** No

Presentation

Objectives

The aim of this course is to present as comprehensive an overview as possible of the societal, technological and environmental issues associated with the energy and ecological transition, including the concepts of life cycle analysis, energy sobriety, digital responsibility and geo-engineering, as well as the state of the art in energy production and storage technologies (renewable solar, wind, marine, power to gas, biomass, biofuels, geothermal, etc.).

Description

- The challenges of energy and ecological transition (6 x 1h45)

Key words: energy transition, climate change, global resources, life cycle analysis

Speakers: Stéphane Amant (Carbone 4): 1 session François Xavier Dugripon: 4 sessions

- Mobility (1 x 1h45) Key words: transport (cars, planes, etc.) Speaker: Stéphane Amant (Carbone 4)

-Life cycle assessment: application to aeronautics (1 x 1h45) Key words: life cycle assessment

Speaker: Laure Couteau (Airbus) Laure Couteau (Airbus)

- Sobriété énergétique (1 x 1h45)

Key words: NégaWatt project

Speaker: Paul Neau (Solagro / Airbus) Paul Neau (Solagro / Asso. NégaWatt / Abies)

- Digital responsibility (1 x 1h45)

Key words: life cycle assessment, environmental impact, data center, corporate social responsibility

Speaker: Emmanuel Laroche (Airbus)

- Geo-engineering (1 x 1h45)

Key words: Earth-scale engineering, actions on the carbon cycle, solar radiation I

speaker : Paul Duru (IMFT)

- Osmosis - blue energy (1 x 1h45) Keywords: electricity generation through osmotic processes Speaker: Olivier Liot (IMFT)

- Wind power (2 x 1h45)

Key words: onshore + offshore wind energy Speaker: Paul Neau (Solagro / Asso. NégaWatt / Abies)

- Solar photovoltaics (2 x 1h45)

Key words: solar panels, storage Speaker: Henri Schneider (Laplace)

- Hydroelectricity (2 x 1h45) Key words: dams, turbines, STEP Speaker : Lionel Dumond (EDF)

- Waves, currents, swell (1 x 1h45)

Key words: wave energy recovery, tidal turbines, wave-motor systems Speaker: Jérôme Mougel (IMFT) Jérôme Mougel (IMFT) 2 / 2

- Concentrated solar power (1 x 1h45) Key words: solar furnace, heat concentrator Speaker: Gilles Flamant (PROMES)

- Biomass, biogas, biofuel (3 x 1h45)

Key words: high-temperature heat treatment, biomass, biogas, biofuel Speakers: Mehrdji Hemati (LGC) : 2 session Marion Alliet (LGC) : 1 session

- Energy storage, power to gas (2 x 1h45) Keywords: electrical or other energy storage, Power to Gas processes Speaker: Amine Jaafar (Laplace)

- Geothermal energy (2 x 1h45)

Key words: geothermal energy/heat recovery

Speaker: Olivier Liot (IMFT) Olivier Liot (IMFT)

- Nuclear power (2 x 1h45)

Key words: current technologies, uranium vs thorium, fission vs fusion

Speaker: Daniel Caruge, Bernard Boullis Daniel Caruge, Bernard Boullis (CEA)

Modélisation et Simulation Numérique (MSN)

ECTS
30 credits

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

In brief

- **Ametys Code:** M4SLE3F1

List of courses

	Nature	CM	TD	TP	Crédits
Soft and Human Skills MF2E S9	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				
Choix de Spécialité-MSN	Choix				
Spécialité-MSN	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
Spécialité-MSN-Env	Bloc				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
Spécialité-MSN-Enr	Bloc				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
Spécialité-MSN-Env-BD	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

Choix de Spécialité-MSN

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

In brief

- **Ametys Code:** N9EMAX

List of courses

	Nature	CM	TD	TP	Crédits
Spécialité-MSN	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
Spécialité-MSN-Env	Bloc				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
Spécialité-MSN-Enr	Bloc				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
Spécialité-MSN-Env-BD	Bloc				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

Spécialité-MSN

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

In brief

- **Ametys Code:** N9EMAX1

List of courses

	Nature	CM	TD	TP	Crédits
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				

PROJECT OF MODELING AND NUMERICAL SIMULATION

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM04

List of courses

	Nature	CM	TD	TP	Crédits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				

Numerical project for Compressible Flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM04A

Numerical project for Incompressible Flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM04B
- **Open to exchange students:** No

Presentation

Objectives

The aim of this BES is to code one of the two methods seen in the Numerical Methods for Incompressible Flows course.

Using a Fortran code skeleton, students will code the projection method with 2 numerical schemes and compare them on the case of the entrained cavity.

Description

Course on numerical methods for incompressible flows

Industrial codes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM04C
- **Open to exchange students:** No

Presentation

Description

Introductory project to an industrial calculation code (NEPTUNE CFD), with familiarization with the software suite, including preprocessing (mesher, input file), calculation launch, and postprocessing, on a fluidized bed problem.

Spécialité-MSN-Env

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

In brief

- **Ametys Code:** N9EMAX2

List of courses

	Nature	CM	TD	TP	Crédits
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				

Spécialité-MSN-Enr

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

In brief

> **Ametys Code:** N9EMAX3

List of courses

	Nature	CM	TD	TP	Crédits
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				

TURBULENCE AND MULTIPHASE FLOWS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM07

List of courses

	Nature	CM	TD	TP	Crédits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				

Physics of incompressible turbulent flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM07A
- **Open to exchange students:** No

Presentation

Objectives

This course describes the physical processes associated with energy transfer mechanisms in incompressible turbulent flows. It introduces the tools for describing and analyzing these flows. On completion of this course, students will be able to

describe the physical mechanisms at work in turbulent flows
calculate observables characterizing these flows
analyze data from experiments or numerical simulations
compare observations with existing theories
use the mathematical formalism introduced in the course to describe and analyze other complex physical phenomena

Description

- Introduction

- Vorticity dynamics

- Link between energy, enstrophy and dissipation

- Phenomenological presentation of the energy cascade

- Description of isotropic homogeneous turbulence in physical space

- Description of isotropic homogeneous turbulence in spectral space

- Presentation of Kolmogorov's theory and its limitations

Two phase flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM07B
- **Open to exchange students:** No

Presentation

Objectives

Introduce students to the complex dynamics of two-phase flows. The physics of these flows is introduced by writing and analyzing balances (mass, momentum and energy) at the interface between two fluids. These balances are then used to write the general equations for two-phase media. The physical mechanisms present in such flows are then introduced by describing the transfers (forces, mass, heat, phase change, rupture, coalescence) encountered in flows made up of particles (bubbles, drops or solid particles).

Description

- Mass, momentum and energy balances at interfaces.
- General equations of two-phase media.

- Introduction to 1-Fluid and 2-Fluid approaches

- Simple solutions: evaporation of a film or drop, two-phase Couette flow.
- Forces exerted on a particle (drag, lift, added mass, etc.).

Transfers in two-phase and turbulent media

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM07C
- **Open to exchange students:** No

Presentation

Objectives

This course introduces the transfer mechanisms observed in turbulent two-phase flows.

The first part of the course recalls the similarities and differences between mass and heat transfer. In the context of dispersed flows, it describes the transfer laws (Sherwood and Nusselt numbers) at the scale of bubbles, drops and particles. These concepts are applied to study oxygen transfer in a bubble column, either by injecting air bubbles or pure oxygen bubbles. The transfer equation is then derived in the context of 2-fluid approaches.

The second part of the course deals with transfer in turbulent flow. The notions of thermal and mass boundary layers in turbulent flow are presented. The statistical description of mixing in homogeneous turbulence is presented, along with the scaling laws that characterize it and their dependence on Reynolds and Schmidt/Prandtl numbers. Finally, these concepts are applied to the estimation of mixing in partially premixed reactors.

Description

Introduction: examples of industrial and environmental applications -

I. Analogies and differences between mass transfer and heat transfer. Nusselt and Sherwood numbers

II. Transfers on the scale of fluid particles (bubbles and drops). Demonstration of generic scaling laws as a function of the nature of the interface.
III. Application to oxygen transfer in a bubble column

IV. Analysis of experimental transfer measurements in a bubble column.

V. Introduction to the concepts of mixing in turbulent flows.

Spécialité-MSN-Env-BD

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

In brief

> **Ametys Code:** N9EMAX4

List of courses

	Nature	CM	TD	TP	Crédits
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

MODELING

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM01

List of courses

	Nature	CM	TD	TP	Crédits
Models for Interfaces	Matière				
Modélisation de la turbulence	Matière				

Models for Interfaces

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM01A
- **Open to exchange students:** No

Presentation

Objectives

Numerical simulation of flows at a deformable interface (with a solid or other liquid) is relevant to a wide range of applications, including the environment, geophysics, engineering and fundamental physics. This course presents numerical methods for solving the Navier-Stokes equations at deformable interfaces. Specific problems are induced by this type of geometry: position and deformation of the interface (generally in motion), modification of the topology (rupture-coalescence) and consideration of the discontinuity of physical quantities across the interface (density, viscosity, pressure, etc.).

Description

The methods presented can be divided into two groups, depending on the type of mesh used to solve such problems.
For evolutionary mesh methods (Lagrangian methods), the interface is a boundary between two subdomains. Two main methods are presented: integral boundary methods (Stokes flow or potentials) and direct methods where the Navier-Stokes equations are solved in each phase in curvilinear coordinates and the mesh is adaptive. For fixed-mesh methods (Eulerian methods), the interface moves on a fixed grid. Different methods for tracking the interface are presented: marker methods, Level set or Volume of Fluid (VOF) using either a front capture or front tracking method.

Modélisation de la turbulence

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9XPOF

HIGH PERFORMANCE COMPUTING

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM03

List of courses

	Nature	CM	TD	TP	Crédits
Advanced Languages for programming	Matière				
Advanced Techniques for Scientific computing	Matière				
Meshing, Pre and Post Processing	Matière				

Advanced Languages for programming

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM03A
- **Open to exchange students:** No

Presentation

Description

A Python programming project using the Git collaborative development platform for numerical simulation applications in fluid mechanics.

Advanced Techniques for Scientific computing

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N9EM03B
- **Open to exchange students:** No

Presentation

Description

Introduction to shell language and high-performance scientific computing on supercomputers.

Meshing, Pre and Post Processing

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N9EM03C
- **Open to exchange students:** No

Presentation

Objectives

The aim of this course on meshing is to make students self-sufficient in the creation of geometry (CAD), and in the creation of meshing (structured, unstructured, hexahedral, tetrahedral, polyhedral, hybrid, boundary layer, surface mesh, etc.): basic concepts, role and importance of meshing and its quality in numerical simulation (including HPC), presentation of different meshing algorithms (front advance, empty sphere, etc.). The aim is for students to clearly understand what they are doing when using a mesher, and to critically analyze their meshing in terms of the solver they want to use and the physics to be solved.
The main mesh types (triangular and tetrahedral, quadrangular and hexahedral, hybrid, surface and volume, polyhedral, etc.) are detailed. The algorithms used in free (Salome, Gmsh) or commercial (Ansys tools, Simail) mesh generators are presented.
A set of rules and best practices for mesh generation is outlined, along with the quality criteria associated with different types of mesh.
Particular emphasis is placed on tips for formatting and enhancing the value of simulation results, in order to make the most of the results obtained in this course as well as in the BEI or later in their careers.

Description

- Meshing course
 Introduction / Examples
 Numerical methods and meshes
 Triangular and tetrahedral meshing algorithms

Quadrangular and hexahedral meshing algorithms
Hybrid methods
Surface meshes
Polyhedral meshes
Good meshing practices / Quality criteria
General conclusion on meshes
Meshes available at ENSEEIHT
Geometry construction principles

VISU and POST-PROCESSING course
Introduction
Technical constraints (images and videos)
Creating a quality video
Quality visualization: pitfalls to avoid, formatting, content, making the most of results

- Commercial / free viewing software
Viewing and post-processing tools available at ENSEEIHT

- TUTORIAL
- 4 hours working together on a subject with Salome, the project manager, to validate the basic concepts.
- Mini-projects: In pairs, students carry out mini-projects in which they choose the subject to be meshed (ramjet, arrow, triumphal arch, atmospheric re-entry module, submarine, airship, shell, platypus, etc.), the mesher (Salome, Gmsh, Ansys tools, StarCCM+, simail, comsol, etc.) they want to use and the solver (Code_Saturne, Ansys, StarCCM+, etc.). These mini-projects are assessed in an oral presentation. The meshes generated must have been run on the solver of their choice ...

NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM05

List of courses

	Nature	CM	TD	TP	Crédits
Numerical methods for incompressible flows	Matière				
Numerical methods for compressible flows	Matière				
Data Assimilation	Matière				

Numerical methods for incompressible flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM05A
- **Open to exchange students:** No

Presentation

Objectives

Present the main algorithms used for the numerical simulation of incompressible flows, in particular those to be found in major industrial codes.

Description

After recalling the particularities of the incompressible Navier-Stokes equations, we will detail the 2 main families of algorithms used to solve these equations numerically by volume or finite difference approaches: projection methods and segregation methods. We will then present the most efficient techniques for solving large linear systems obtained after discretization of the equations.

Pre-requisites

1st year course on numerical methods

Numerical methods for compressible flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM05B
- **Open to exchange students:** No

Presentation

Objectives

The aim of this course is to introduce the main numerical methods used to solve the equations governing hyperbolic conservation laws. Particular attention will be paid to gas dynamics and free-surface flows, and more generally to nonlinear hyperbolic problems generating discontinuities such as shock waves.

Description

After underlining the specificities of these flows from the point of view of numerical modeling, modern numerical techniques for capturing discontinuities (Riemann solvers, flow decomposition schemes, etc.) will be presented. We'll take a closer look at methods for increasing order (MUSCL method). We will also look at the discretization of boundary conditions for hyperbolic problems.

Pre-requisites

1st year course on numerical methods

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

TOULOUSE INP N7

Data Assimilation

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM05C
- **Open to exchange students:** No

Presentation

Description

The aim of this course is to introduce the essentials of the data assimilation method (modifying the results of a numerical model over time by taking into account external observation data).

Fluide et Procédés (FEP)

ECTS
30 credits

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

In brief

- **Ametys Code:** M4SKGKRO

List of courses

	Nature	CM	TD	TP	Crédits
Soft and Human Skills MF2E S9	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
CHOIX 2 sur 3 SHS MF2E S9	Choix				
Hydraulic operating control	Matière				
Controversies in a world in transition	Matière				
RSE (MF2E)	Matière				
CHOIX 1 sur 2 SHS MF2E S9	Choix				
Entrepreneurship Project	Matière				
Corporate Project and social responsability	Matière				
Choix Harmonisation	Choix				
HARMONISATION A7	UE				
Initiation Linux/Harm.A7	Matière				
Reminder of fluids mechanics and introduction to turbulence	Matière				
Dynamics of bubbles, drops and particles	Matière				
HARMONISATION N7	UE				
Material transfer	Matière				
Reactor sizing	Matière				
Choix de Spécialité-FEP	Choix				
Spécialité-FEP	Bloc				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				
Piston engines Project	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				
Spécialité-FEP-Aéro	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				

Choix Harmonisation

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EMCI

List of courses

	Nature	CM	TD	TP	Crédits
HARMONISATION A7	UE				
Initiation Linux/Harm.A7	Matière				
Reminder of fluids mechanics and introduction to turbulence	Matière				
Dynamics of bubbles, drops and particles	Matière				
HARMONISATION N7	UE				
Material transfer	Matière				
Reactor sizing	Matière				

HARMONISATION A7

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM14

List of courses

	Nature	CM	TD	TP	Crédits
Initiation Linux/Harm.A7	Matière				
Reminder of fluids mechanics and introduction to turbulence	Matière				
Dynamics of bubbles, drops and particles	Matière				

Initiation Linux/Harm.A7

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM14A

Reminder of fluids mechanics and introduction to turbulence

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 10
- **Ametys Code:** N9EM14B

Presentation

Objectives

Reminder on local balances in fluids mechanics (mass and momentum balances)

Description of the transition to turbulence.

Write Navier-Stokes equations with Reynolds averaging.

Obtain the profile mean velocity in a turbulent channel

Description

Differential operators and calculation with matrices

Navier-Stokes equations in cartesian, cylindrical, spherical coordinates

Couette and Poiseuille laminar flows

Transition to turbulence

Navier-Stokes equations with Reynolds averaging

Pre-requisites

Basic knowledge on differential operators and matrices

Mass and momentum balances in fluids mechanics

Dynamics of bubbles, drops and particles

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM14C
- **Open to exchange students:** No

Presentation

Objectives

This course provides the basis for understanding and modeling dispersed flows containing bubbles, drops or solid particles. Local dynamics are studied by writing the equation of the trajectory involving the forces of drag, history and added mass, in order to introduce the notions of terminal velocity, relaxation time and Stokes number.

Description

Introduction: examples of industrial and environmental applications - Differences between bubbles, drops and solid particles
I. Solid particle dynamics: forces, drag laws, terminal velocity, relaxation time, Stokes number
II. Fluid particles (bubbles and drops): forces, drag laws, terminal velocity, relaxation time, Stokes number
III. Application examples

HARMONISATION N7

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM15

List of courses

	Nature	CM	TD	TP	Crédits
Material transfer	Matière				
Reactor sizing	Matière				

Material transfer

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM15A
- **Open to exchange students:** No

Presentation

Objectives

Give students the tools they need to model material transfer phenomena.

Description

Introduction: Process schematization, Role of matter transfer in the process, Classification of matter exchangers.
Definition of tools: Molecular diffusion, Knudsen diffusion, Determination of diffusion coefficients in gas, liquid and solid phases, Continuity laws.
Transfer in one phase (transient and steady state, laminar flow), Numerical applications (5 exercises).
Structure of the transfer coefficient, Influence of transfer intensity on the transfer coefficient, Obtaining transfer coefficients, Some examples of correlations.
Material transfer between phases (Film model, Double film theory, Transfer coefficients between phases, Penetration theory).
Introduction to film, bubble, drop and particle mass exchangers.
Notions common to mass exchangers (Expression of flow rates and flows, Exchange potential difference diagram, Global, partial and differential balances, number and height of transfer units).
Sizing method.

Reactor sizing

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM15B
- **Open to exchange students:** No

Presentation

Objectives

Gain an understanding of the methodologies involved in modeling and sizing process engineering equipment, using chemical reactors as an example. In particular, take into account coupled phenomena and put them into equations (mass and heat balances).

Description

Contents

- Types of reactor technologies according to industrial fields and operating constraints: examples, diagrams and photos, operating principle.

- The 2 ideal models for modeling reactors: notion of “ideal” flow, residence time, calculation of progress and productivity; writing of mass and heat balances for these 2 simplified models.

- Taking into account the non-ideality of flow in a device: notion of degree of mixing (“dispersion”), residence time distribution (DTS), specific adimensional number (Péclet); models for estimating the rate of advancement: series tanks or “piston-dispersion”.

- Multiphase reactors: example of fixed-bed catalytic reactors, notion of coupled phenomena (at catalyst grain scale), transfer resistances, apparent reaction, related adimensional numbers (Thiele modulus, Biot numbers); phenomenological approach to multi-scale sizing.

Choix de Spécialité-FEP

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

In brief

- **Ametys Code:** N9EMCX

List of courses

	Nature	CM	TD	TP	Crédits
Spécialité-FEP	Bloc				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				
Piston engines Project	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				
Spécialité-FEP-Aéro	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				
Piston engines Project	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				
Spécialité-FEP-Proc-Aéro	Bloc				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
PROCESSES : PHYSICS AND MODELLING	UE				5 credits
Microfluidique	Matière				
Energy optimization of thermodynamic steam cycles	Matière				
Transfer in Porous media	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				

Spécialité-FEP

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

In brief

> **Ametys Code:** N9EMCX1

List of courses

	Nature	CM	TD	TP	Crédits
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				
Piston engines Project	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				

NUMERICAL SIMULATIONS - FLUID PARTICLES

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM20

List of courses

	Nature	CM	TD	TP	Crédits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				

Turbulence Models f/Stationary Numerical Simulations

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM17A
- **Open to exchange students:** No

Presentation

Objectives

Study the different first-order turbulence models used in industrial codes, specifying their advantages and disadvantages.

Description

After recalling the principle of first-order turbulence models, we'll look in detail at the different models used in industrial codes, showing their respective qualities and shortcomings. We'll also describe the different types of laws or models used to treat near-wall turbulence, and their practical implementation.

Simulation of industrial flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM17C

Presentation

Objectives

Deepen knowledge of a computational code by putting yourself in complex situations both in terms of mesh and turbulence model. The modeling of three-dimensional situations is highlighted.

Analyzing a flow situation
Determine conditions at limits by interpreting numerical results
offer adapted transport models
compare its results to theoretical predictions

Pre-requisites

CFD Tools basic and advanced

fluid mechanics knowledge

Thermal transport

Porous media

Simulation of a fluidised bed

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N9EM20B
- **Open to exchange students:** No

Presentation

Objectives

Train students in the use of a massively parallel computational fluid mechanics code for reactive multiphase flows (NEPTUNE_CFD code based on an Euler N-fluid approach) on an industrial scale, applying it to the simulation of gas-particle flows, particularly in fluidized beds.

Description

Train students in the use of a massively parallel computational fluid mechanics code for reactive multiphase flows (NEPTUNE_CFD code based on an Euler N-fluid approach) on an industrial scale, applying it to the simulation of gas-particle flows, particularly in fluidized beds.

- Interactive discussion with students on numerical simulation:
. main stages, organization of an industrial calculation code
. modeling and transition from a physical problem to numerical simulation

. highlighting the key points in solving a real problem and their relationship with the various components of the code: phase properties, boundary conditions, initial conditions, models, diagrams, numerical methods, etc.

- Implementation of the complete calculation chain of a numerical simulation on a dense flow (fluidized bed): creation of the geometry, creation of the mesh, parameterization of the calculation case, choice of models, modification of source files, launch/compilation/execution of the calculation, visualization and critical analysis of the results and study of the influence of parameters (link with the process and its optimization). Theoretical review of two-phase flow closure models in terms of interfacial transfer, turbulence in the continuous phase, particle stress modeling and coupling between the continuous and dispersed phases.

- Study of the influence of agitation models on a gas/particle jet: implementation of the calculation chain: geometry, meshing, parameterization of the calculation case, execution, post-processing and physical analysis of the results, study of the influence of the particle agitation model on particle dispersion.
- Design office projects on simplified geometries for multiphase industrial processes with or without heat and material transfer

REACTIVE MEDIA

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM21

List of courses

	Nature	CM	TD	TP	Crédits
Combustion	Matière				
Piston engines Project	Matière				

Combustion

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM21A
- **Open to exchange students:** No

Presentation

Objectives

Introduction to the basics of combustion for students familiar with fluid mechanics of non-reactive media. Theoretical aspects and numerical implications. Flame temperatures, laminar flame velocities, diffusion flame structure, turbulent reactive flows, combustion instabilities. Application to piston engines and gas turbines.

Description

- Introduction to combustion, refresher course
- Basic equations of combustion
- Premixed laminar flame: theory and calculation codes
- Turbulent premixed flames: models, direct simulations
- The laminar diffusion flame: theory and calculation
- Turbulent diffusion and premixing flames: physical description and models for calculation codes
- Flame-wall interaction, ignition, pollution.
- Combustion instabilities

Piston engines Project

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM21B
- **Open to exchange students:** No

Presentation

Objectives

The aim of this BES is to enable students to tackle many of the multiple problems posed by piston engines and their design. In the course of this work, they will be required to work on the following disciplines: thermodynamics, thermics, fluid mechanics, acoustics, vibrations, combustion...

Description

The project is divided into two parts:

A/ Thermodynamic cycle and dimensioning of a piston engine. This part is common to all students.

B/ In-depth study of 1 or 2 of the following topics:

B1/ Direct fuel injection

B2/ Engine cooling

B3/ Valve sizing

B4/ Study of engine combustion

This second part is left up to the students, who must decide for themselves which study interests them most. Depending on how far they have progressed, teachers may decide to go further in just one of the B studies, or to carry out two B studies which in some cases complement each other.

ECOULEMENTS FLUIDE-PARTICULES

ECTS
5 credits

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

In brief

- **Ametys Code:** N9EM22

List of courses

	Nature	CM	TD	TP	Crédits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				

PhysicoChemical hydromatics : colloidal susp.

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM18C
- **Open to exchange students:** No

Presentation

Objectives

The situation in which we seek to separate a fluid from particles dispersed within it is encountered in many industrial processes (decantation and filtration, for example), involving suspensions of various kinds (water to be purified, milk, mining effluents, etc.). The aim of this course is to introduce the main hydrodynamic and physico-chemical effects at work within a suspension of colloidal particles, ingredients that need to be taken into account when working on the scale of a separation process.

Description

I. Suspension hydrodynamics: micro-hydrodynamics and sheared suspensions

II. Physical chemistry of suspensions: van der Waals interactions, electrostatic interactions. DLVO approach. Aggregation, electrokinetic effects and transport.

III. Separation processes: flotation, decantation/sedimentation, filtration

TDs: Granulometric sorting, Settling tank, Sedimentation of fractal aggregates, Filtration laws, Concentration of colloidal suspensions during tangential filtration.

Gas-particle flows

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 35
- **Ametys Code:** N9EM19A

Presentation

Objectives

Introduction to mathematical modelling and numerical simulation approaches developed for gas-particle reactive flows in dense or dilute regime encountered in the industrial fields of energy, transport and process engineering, but also in the fields of health and the environment.

Qualitative presentation of gas-particle flows encountered in the fields of transport, energy, process, health and environment, and the challenges of modelling, based mainly on the teacher's industrial partnership activities.

Introduction of the macroscopic parameters characterising this type of flow: temperature, pressure, particle diameter, mass density, volume fraction, numerical density, mass load, etc.

Description

Introduction

Qualitative presentation of the phenomena and issues involved in modelling gas-particle flows encountered in the fields of transport, energy, process, health and environment, based mainly on the teacher's industrial partnership activities.

Introduction of the macroscopic parameters characterising this type of flows: temperature, pressure, particle diameter, mass density, volume fraction, numerical density, mass load, etc.

General presentation of the mathematical modelling and numerical simulation methods for dispersed phase flows and their multi-scale articulation by analogy with the kinetic theory of gases: direct or fully resolved simulation on a small scale, deterministic Euler-Lagrange modelling on a mesoscale, statistical modelling and methods of moments (or N-fluid model) on a macro scale.

Deterministic Lagrangian modelling of particles

- Momentum equation and modelling of fluid-particle (drag, Archimedean, jet propulsion) and particle-particle (collision) transfers in dense and dilute regimes.

- Enthalpy equation and modelling of fluid-particle transfers (thermal diffusion and mass transfer).

- Mass equation and modelling of fluid-particle transfers (evaporation/condensation of droplets, pyrolysis and gasification of biomass, heterogeneous catalysis reaction) and particle-particle (coalescence, break-up and attrition).

Statistical modelling of particle clouds

Introduction of the joint distribution function of velocity, mass and enthalpy for a particle ensemble, and of the corresponding averaging operator.

Writing of the Liouville equation (or kinetic or Boltzmann-type) which governs the distribution function.

Closure of this equation in connection with the Lagrangian deterministic modelling of fluid-particle and particle-particle transfers. Semi-empirical introduction of the BGK model for the representation of the effect of collisions between elastic particles.

Macroscopic modelling of particulate flow

Definition of the moments of the particulate phase (numerical density, mean mass, mean velocity, random kinetic energy, mean temperature, kinetic stress tensor, etc.).

General introduction to the method of deriving macroscopic equations from the Liouville equation. Reformulation of the collision term as the sum of a pair modification source term and a collision flow term.

Application to mass balance, numerical density balance and momentum balance equations. Analysis of closure problems and proposal of models: fluid-to-particle mass transfer, mixing of particle species and coalescence, fluid-to-particle momentum transfer (fluid-to-particle turbulent drift velocity) and introduction of kinetic and collisional viscosities.

Application

The exam consists of a work carried out for about 4 hours with the help of the teacher in charge. The aim of this work is to study a real gas-particle flow configuration and to apply the skills acquired in the course to the modelling and simulation of these flows. For example, this could be the application of the course to the modelling of a dust storm or the de-nebulization of fog at an airport.

Pre-requisites

Modelling of transport and transfers in single-phase laminar, anisothermal and reactive flows

Turbulent dispersion and mixing (temporal and spatial scales of turbulence, turbulent viscosity, turbulent dispersion)

Introduction to statistical modelling (multivariate probability density, normal distribution)

Knowledge of the kinetic theory of diluted gases is recommended.

Useful info

Contacts

Responsable pédagogique

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Granular media

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM19C

Spécialité-FEP-Aéro

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

In brief

- **Ametys Code:** N9EMCX2

List of courses

	Nature	CM	TD	TP	Crédits
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				
Piston engines Project	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				

Spécialité-FEP-Proc-Aéro

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

In brief

- **Ametys Code:** N9EMCX3

List of courses

	Nature	CM	TD	TP	Crédits
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
PROCESSES : PHYSICS AND MODELLING	UE				5 credits
Microfluidique	Matière				
Energy optimization of thermodynamic steam cycles	Matière				
Transfer in Porous media	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				

PROCESSES : PHYSICS AND MODELLING

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM18

List of courses

	Nature	CM	TD	TP	Crédits
Microfluidique	Matière				
Energy optimization of thermodynamic steam cycles	Matière				
Transfer in Porous media	Matière				

Microfluidique

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9X96Q

Energy optimization of thermodynamic steam cycles

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9X9AJ
- **Open to exchange students:** No

Presentation

Description

- The course on Liquid-vapour thermodynamic cycle deals with the optimisation of energetic processes used to produce power (power cycles) or to transfer heat (refrigeration cycles and heat pump cycles).
- Cogeneration and heat recovery cycles will also be analyzed in the perspective of efficiency increase and energetic transition.
- The software thermoptim will be used to design and optimise complex cycles.

Transfer in Porous media

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM19B
- **Open to exchange students:** No

Presentation

Objectives

The aim of this course is to present some aspects of transport in porous media from the pore scale to the porous medium scale. At the pore scale, specific small-scale hydrostatic effects will be presented, then electrokinetic transport related to surface charges at the walls will be described. Next, a description of porous media and their properties will be proposed, followed by averaging methods for translating local transport equations into global ones. The first application will be hydrodynamic transport through a porous medium, with a demonstration of Darcy's law. This will be followed by two lectures on dispersion and diffusion in porous media, both for particle/molecular transport and heat transfer.

Translated with DeepL.com (free version)

Description

1/ Pore-scale hydrostatics

At the end of this part, students should be able to :

Explain the effects of surfaces on small-scale hydrostatics
Demonstrate the main relations linked to surface tension (Young, Jurin, Laplace)
Summarize the main electrokinetic transfers in a pore (electroosmosis, diffusio-osmosis, etc.)
Adapt the preceding notions to solve a coupled transport problem
2/ Averaging: from pore to porous medium

At the end of this section, students should be able to :

Describe some natural and artificial porous media
Define Knudsen's number
Define and explain the main properties of a porous medium (tortuosity, porosity, saturation)
Explain what the Representative Elementary Volume is
Summarize the different averaging methods for porous media
Calculate the spatial average of a scalar or vector field in a porous medium
3/ Hydrodynamic transport in a porous medium

At the end of this section, students should be able to :

Summarize and interpret Darcy's law
Estimate the permeability of certain porous media
Cite experimental methods for measuring permeability
Define the Klinkenberg effect
Apply Darcy's law with inertia, and its consequence on permeability (Ergun's law)
Choose the right approach for evaluating hydrodynamic transport in a porous medium

4/ Particle diffusion and dispersion in porous media

At the end of this part, students should be able to :

Name the different types of dispersion mechanisms in a porous medium
Write and apply Fick's law
Demonstrate Taylor dispersion in a cylinder
Describe the phenomenon of diffusion in a porous medium
Write and interpret the averaged advection-diffusion equation
5/ Heat transfer in a porous medium

At the end of this section, students should be able to :

Name and describe the three mechanisms of heat transfer in porous media
Summarize the thermal conduction model in porous media
Interpret the different thermal conductivity models
Summarize the thermal convection model in porous media
Define Rayleigh and Nusselt numbers in porous media
The exam will mix the analysis of a scientific article with one or more classical exercises related to the above objectives.

Translated with DeepL.com (free version)

Spécialité-FEP-Proc

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

In brief

- **Ametys Code:** N9EMCX4

List of courses

	Nature	CM	TD	TP	Crédits
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
PROCESSES : PHYSICS AND MODELLING	UE				5 credits
Microfluidique	Matière				
Energy optimization of thermodynamic steam cycles	Matière				
Transfer in Porous media	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				

Spécialité-FEP-FEIP

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

In brief

- **Ametys Code:** N9EMCX5

List of courses

	Nature	CM	TD	TP	Crédits
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
MULTIPHASE FLOWS PROCESSES	UE				5 credits
Two-phase flows with phase changes	Matière				
Two-phase hydraulics	Matière				
Coalescence Rupture Aggregation	Matière				
NUMERICAL SIMULATIONS - PROCESS	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Digital Disphasic	Matière				
Simulation of industrial flows	Matière				
Multiphysics coupling	Matière				
PROCESSES : PHYSICS AND MODELLING	UE				5 credits
Microfluidique	Matière				
Energy optimization of thermodynamic steam cycles	Matière				
Transfer in Porous media	Matière				

MULTIPHASE FLOWS PROCESSES

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM16

List of courses

	Nature	CM	TD	TP	Crédits
Two-phase flows with phase changes	Matière				
Two-phase hydraulics	Matière				
Coalescence Rupture Aggregation	Matière				

Two-phase flows with phase changes

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM16A
- **Open to exchange students:** No

Presentation

Objectives

The aim of this course is to provide future engineers with tools for modeling and sizing thermal-hydraulic installations involving liquid-vapor flows (boiling and condensation). The course focuses on formulating and solving the equations for conservation of mass, momentum and energy for two-phase flows with phase change. Modeling of heat and mass transfer terms in boiling, condensation and evaporation are presented, enabling initial sizing of two-phase heat exchangers in simple geometries.

Description

-Formulation of conservation equations integrated in a pipe section: main variables and closure laws
Adiabatic and mass-transfer flow configurations
-Vase boiling regimes (Nukiyama curve)
-Convective boiling regimes
-Parietal and interfacial friction modeling
-Heat and mass transfer in convective boiling
-Heat and mass transfer in convective condensation
-Study of parametric effects on boiling/condensation transfers (pressure, incondensables, subcooling, etc.)

Pre-requisites

Two-phase flows" course (DIPH)

Two-phase hydraulics" course (HYDI)

Two-phase hydraulics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM16B
- **Open to exchange students:** No

Presentation

Objectives

The aim of this course is to provide engineering students with the tools they need to model and calculate the hydrodynamic behavior of two-phase flows in industrial situations. These flows are extremely varied, due to the multiplicity of flow configurations that can exist (flows where one phase is dispersed in the other, where the phases are clearly separated, or where the phases flow intermittently: bubble reactors in water treatment, liquid film flows, oil transport in pipelines).

Description

- Classification of flow configurations.

- Equation of one-dimensional mass and momentum balances (averaged over the section).

- Presentation of the hierarchy of hydrodynamic coupling models between phases (two-fluid model, mixing models (drift-flow model, homogeneous model).

- Application to one-dimensional flows: - stratified flow, - bubble flow, - intermittent flow, and - annular flow.

Coalescence Rupture Aggregation

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM16C
- **Open to exchange students:** No

Presentation

Objectives

Provide future engineers with a basic understanding of the physical mechanisms controlling the structure of interfaces in dispersed media: bubble flows, emulsion flows and flows with aggregates. Develop appropriate models for calculating the spatio-temporal evolution of bubble/drop/particle populations in two-phase processes.

Description

I- Introduction to dispersed media engineering: Application examples (emulsification, precipitation, filtration) - Transfer coefficients - Interfacial area - Size distribution functions and their moments.

II- Modeling population evolution using population balance equations: source and sink terms.

III- Application: particle aggregation kernel by Brownian or shear-induced agitation.

IV- Gas-liquid and liquid-liquid interfaces: interfacial tension, effects of surfactants, consequences for interfacial phenomena.

V- Rupture: physical problem and models for population balances (fragmentation nuclei for bubble and droplet flows), (i) in viscous, (ii) inertial and (iii) turbulent flow. Examples of applications for breaking bubbles in stirred tanks or drops in emulsification processes.

VI - Coalescence: description of the physics, focus on the hydrodynamics of film drainage between bubbles or drops, models for population balances. Application examples and limits of these approaches.

BE: modeling the evolution of the size distribution of a population in a given two-phase process: physical analysis of the mechanisms, establishment of simple models and simulation of the output size distribution as a function of hydrodynamics.

NUMERICAL SIMULATIONS - PROCESS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM17

List of courses

	Nature	CM	TD	TP	Crédits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Digital Disphasic	Matière				
Simulation of industrial flows	Matière				
Multiphysics coupling	Matière				

Digital Disphasic

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM17B
- **Open to exchange students:** No

Presentation

Objectives

The aim of this course is to put into practice the theories of thermohydraulics and two-phase hydraulics seen previously. One of the following two software packages will be used: Ledaflow or Cathare: Ledaflow or Cathare.

Description

Ledaflow: this software is mainly used in petroleum applications. The severe slugging phenomenon will be studied. Based on an experimental article, the aim is to reproduce the results using numerical simulation. The intervention of a person from Total will give a better understanding of the industrial stakes of this software.

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

- Cite Ledaflow's fields of application- Illustrate Ledaflow's basic functions with an example- Simulate severe slugging from experimental data- Classify experimental results in an article- Compare experimental and numerical results- Summarize work in a report.

Cathare: this software is mainly used in nuclear applications. We will study the phenomenon of siphon-breaking. Based on an experimental article, the aim is to find the results using numerical simulation. The contribution of a member of EDF's staff will provide a better understanding of the industrial implications of this software. At the end of this course, students should be able to :

- Cite Cathare’s fields of application

- Illustrate Cathare’s basic functions with an example

- Simulate a siphon-breaker using experimental data

- Classify experimental results in an article- Compare experimental and numerical results-

- Summarize the work in a report A report of at least 10 pages, related to these objectives, should be written.

Multiphysics coupling

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EM17D
- **Open to exchange students:** No

Presentation

Objectives

- Simulate and analyze in depth (in conjunction with associated theoretical material) coupling configurations between hydrodynamics, transfers and reaction on the basis of DNS-type simulations: (i) transfer around and within a catalyst particle in a flow and (ii) numerical tracing of a reactor.
- Simplify these studies by establishing 1D phenomenological models used in reactor engineering
- Implement a multi-scale simulation on a fixed-bed catalytic reactor configuration based on a coupling between these 1D models.

Description

Teaching method: 3-part project.

The aim of this project is to use COMSOL Multiphysics to solve the equations governing hydrodynamics, transfer and reaction in a single-phase fixed-bed reactor. The problem is complex because of the different phenomena involved and the various scales involved, from the molecular to the reactor scale. Reaction engineering introduces various concepts to simplify the description of the phenomena involved - among them the efficiency factor to correct the reaction rate by limitations due to internal diffusion and external transfer, and the axial dispersion coefficient to correct the deviation of real hydrodynamics from plug flow (perfect fluid flow model). Using problems that first describe the catalyst grain and reactor scales separately, before coupling them together, these different concepts are introduced and their validity discussed by comparison with "exact" solutions solved using the COMSOL tool.

Program/Content

- Coupling between transport phenomena (internal/external) and reaction at the scale of a catalyst particle: "exact" 2D axial simulation and determination of limiting processes; comparison of the resulting global efficiency factor with simplified expressions from reaction engineering (1D particle diffusion-reaction model associated with the film model).

- Numerical tracing within a tubular reactor (vacuum) in laminar flow: introduction to axial dispersion and comparison of Taylor-Aris dispersion and segregated flow regimes; analysis of the Residence Time Distribution and determination of the equivalent axial dispersion coefficient; comparison of the predictions of the 1D piston-dispersion model with the "exact" solution (in the Taylor-Aris regime).

- Multi-scale coupling (catalyst grain / interstitial fluid) within a fixed-bed catalytic reactor.

Spécialité-FEP-FEIP-Comb

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

In brief

- **Ametys Code:** N9EMCX6

List of courses

	Nature	CM	TD	TP	Crédits
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
MULTIPHASE FLOWS PROCESSES	UE				5 credits
Two-phase flows with phase changes	Matière				
Two-phase hydraulics	Matière				
Coalescence Rupture Aggregation	Matière				
NUMERICAL SIMULATIONS - PROCESS	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Digital Disphasic	Matière				
Simulation of industrial flows	Matière				
Multiphysics coupling	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				
Piston engines Project	Matière				

Éco-Énergie (EE)

ECTS
30 credits

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

In brief

- **Ametys Code:** M4SLFSLS

List of courses

	Nature	CM	TD	TP	Crédits
SYSTEMIC DESIGN	UE				5 credits
System modeling in Bond Graph	Matière				
Eco-design and LCA	Matière				
Hydrogen supply chain	Matière				
Optimization of energy processes and systems	Matière				
SMART-GRIDS	UE				5 credits
Decentralized, embedded electrical networks	Matière				
Energy Hybridization of Systems	Matière				
Smart grids	Matière				
RENEWABLE ENERGIES	UE				5 credits
Wind Power Systems	Matière				
Photovoltaic APP	Matière				
Low-Power Hydroelectric Installations	Matière				
GENERAL TRAINING	UE				5 credits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
Themed Day: Energy and Sustainable Development	Matière				

SYSTEMIC DESIGN

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE34
- **Open to exchange students:** Yes

List of courses

	Nature	CM	TD	TP	Crédits
System modeling in Bond Graph	Matière				
Eco-design and LCA	Matière				
Hydrogen supply chain	Matière				
Optimization of energy processes and systems	Matière				

System modeling in Bond Graph

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE34B
- **Open to exchange students:** Yes

Presentation

Objectives

At the end of the course, the student will have mastered the Bond Graph formalism, knowing the various basic elements and the rules for connecting these elements.

They will be able to analyze the various couplings in a system, identifying the system's causal loops.

The student will also be able to determine the transfer function of the system from the Bond Graph model established.

Description

The course introduces the Bond Graph modeling approach. This is a multi-physics approach that makes it possible to model different physical phenomena in the same language, and to take into account the various couplings between the components of a system. This approach is applied in this course to various examples of multi-flow and multi-physics systems.

The course is rounded off by a project involving the modeling of an electro-hydrostatic actuator (EHA) on an A320 aircraft using the Bond Graph approach, and the replacement of the EHA's power source by a fuel cell hybridized with super-capacitors.

Pre-requisites

Basic knowledge of physical systems.

Eco-design and LCA

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE34C
- **Open to exchange students:** Yes

Presentation

Objectives

- Integrate an eco-design approach into the design of energy systems;

- Identify the steps in the Life Cycle Assessment methodology;

- Be able to analyze and critique a life cycle assessment that has already been carried out;

Know how to apply the life cycle assessment method to the study of an energy system.

Description

Introduction: from life cycle assessment to LCA, ISO 14040 standards

- General principle of LCA

- Presentation of the four stages of LCA:

1-Definition of system objectives :

Purpose and scope of the study ;

Product or system function;

Functional unit and reference flows;

Process tree ;

Application examples;

2- Emissions inventories and extractions

Inventory database (e.g. EcoInvent...)

Example of extractions and emissions inventory (alumina production...)

Extraction and emissions inventory calculation method

Energy balance and CO2 balance

3- Environmental impact analysis

Method for interpreting inventory data

Intermediate characterization: calculation of the intermediate impact score

Damage characterization: calculation of damage characterization score

4- Interpretation

- LCA methodology: iterative approach (preliminary assessment or screening, detailed analysis), manual calculations, summary presentation of existing calculation software.

Program and content of the Design Office :

Carrying out a lifecycle analysis of photovoltaic solar panels, using SimaPro software
Presentation of results in the form of a report and oral presentation.

Hydrogen supply chain

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9Y3LK
- **Open to exchange students:** Yes

Optimization of energy processes and systems

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4R9Y0J5
- **Open to exchange students:** Yes

Presentation

Objectives

Optimization issues are becoming increasingly important in energy systems. The aim of this course is to enable students to master the various optimization methods applied to the design and operation of these systems, with a particular focus on multi-objective approaches. Optimization criteria such as cost, energy efficiency, and environmental indicators are often contradictory, making decision-making particularly complex.

The course also introduces Multi-Criteria Decision Making (MCDM) tools, which enable the selection of a solution from a set of "optimal" solutions, thus providing a structured framework for solving the complex problems faced by energy systems.

Description

- Identification of multi-objective optimization problems: Examples of decisions and criteria in energy system optimization.

- Presentation of the main multi-objective optimization methods: Introduction to optimization and decision support approaches adapted to energy systems.

- Identification of relevant optimization strategies: Selection of appropriate approaches based on the specific characteristics of a given problem.

- Formulation of optimization criteria: Definition of technical, economic, and environmental criteria for the optimization of energy systems.

- Case study in a design office: Analysis of a gas turbine combined heat and power system, with problem formulation, multi-objective optimization, and decision-making based on technical, economic, and environmental criteria.

SMART-GRIDS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE35
- **Open to exchange students:** Yes

List of courses

	Nature	CM	TD	TP	Crédits
Decentralized, embedded electrical networks	Matière				
Energy Hybridization of Systems	Matière				
Smart grids	Matière				

Decentralized, embedded electrical networks

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE35A
- **Open to exchange students:** Yes

Presentation

Objectives

Understand the key issues involved in choosing the architecture and sizing an embedded electrical network in relation to specifications.

Description

At the end of this module, students will know the elements to take into account when sizing an on-board network, such as quality and stability issues, the contribution of hybridization, safety and reliability and EMC.

Pre-requisites

Basic electrical circuits and power balances.

Operation of electrical machines

Energy Hybridization of Systems

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE35B
- **Open to exchange students:** Yes

Presentation

Objectives

By the end of the course, students will be familiar with hybrid system architectures and the energy/power characteristics of energy sources and storage elements.

They will be able to analyze the mission of an energy system, judge the relevance of its hybridization and design and dimension a hybrid system.

The student will also be able to propose an energy management strategy for a multi-source energy system, taking into account the intrinsic characteristics of the associated sources.

At the end of the course, the student will be able to identify the architectures of the hybrid systems and to know the energy/power characteristics of some sources and energy storage elements.

He will be able to analyze the mission of an energy system, to evaluate the relevance of its hybridization and to design a hybrid system.

The student will also be able to propose an energy management strategy of a multi-source energy system by respecting the intrinsic characteristics of the associated sources.

Description

In addition to theories relating to hybridization and energy management of multi-source systems, the course is based on several examples of hybrid energy systems drawn from the Laplace laboratory's experience in this field of research. These examples relate in particular to the transport sector (aeronautics, rail and road).

In addition to the hybridization theory and the energy management of multi-source systems, the course is based on several examples of hybrid energy systems from the Laplace laboratory experience feedback. These examples relate in particular to the transport field (aeronautics, rail and road).

Smart grids

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE35E
- **Open to exchange students:** Yes

Presentation

Objectives

The aim of this 4-session course is to make students aware of the emergence of smart grids, distinguishing them from current grids.

The concept of "smart grids", their characteristics and main challenges are introduced in relation to current power grids. The notions of "system services/grid services" (contribution to frequency/voltage reserves, adjustment/shaving, self-consumption, etc.) are presented. Similarly, new degrees of freedom (storage, massive electric mobility, production and consumption predictions, communicating meters, etc. for consumption adjustment, etc.) enabling "intelligent management of electrical networks" are described. As the cost to the user of these new concepts is essential, an overview of market mechanisms and elements of economic models (investment, operation) will enable students to make a "technical-economic" link between energy performance and economic impact. Finally, a few examples of smart grids, and the detailed example of self-consumption in an eco-neighborhood, will provide a more concrete illustration of these concepts.

Description

smart grids are fully in line with the energy transition. Mass electrification is a key route to the necessary decarbonization of the landscape. After mechanization and information technology (the Internet), smart grids are considered to be the 3rd industrial revolution, as they are the essential link for balancing electricity production and consumption, which will become increasingly precarious with the massive integration of intermittent renewable energies (solar, wind). Smart grids are defined by the idea of integrating electrical infrastructure (energy) with Information and Communication Technologies, in order to provide the flexibility needed to solve this power balancing problem in reliable conditions (resilient to faults, cyber-attacks, etc.) and at a cost acceptable to consumers.

Pre-requisites

This course is intended to be introductory and requires only fairly general skills in terms of electrical networks, skills taught in 3rd year 3EA, particularly in the CERE and Eco Energie options.

RENEWABLE ENERGIES

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE36
- **Open to exchange students:** Yes

List of courses

	Nature	CM	TD	TP	Crédits
Wind Power Systems	Matière				
Photovoltaic APP	Matière				
Low-Power Hydroelectric Installations	Matière				

Wind Power Systems

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE36A
- **Open to exchange students:** Yes

Presentation

Objectives

This course, consisting of four to five sessions, introduces the main principles and concepts involved in converting wind energy into electricity, covering everything from the main components of wind turbines to the architecture of modern onshore and offshore wind farms. The course content includes: History, context, and markets for wind power generation. Key market players; factors driving and hindering the expansion of the industry. Cost and development factors for a wind farm.

Characterization of wind resources, effects of altitude and wake, theoretical factors (Betz limit) on wind power generation and the energy efficiency of wind turbines; mechanical control through blade adjustment, from start-up to safe shutdown.

Composition of electric wind turbines: nacelles with and without speed multipliers;

design elements of wind turbine chains according to their size and technology;

Transient analysis and stable adjustment of the operating point in the torque-speed plane;

Main power conversion architectures for asynchronous and synchronous chains with and without gearboxes, with and without power electronics; Elements for adjusting active and reactive power in these energy chains.

Pre-requisites

Basic knowledge of energy physics (energy/power concepts), basic concepts of electricity and electromechanical conversion (basic concepts of electricity generation).

Photovoltaic APP

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE36D
- **Open to exchange students:** Yes

Presentation

Description

I Solar energy: background and general information

II Photovoltaic conversion :

Radiation in space, on Earth, atmospheric mass

Physical principles, PN junction cell, characteristics, influence of irradiance and T

Photovoltaic cell materials and technologies

III From cell to photovoltaic generator, modularity

Cell associations, series and parallel connection, imbalances and protection

Modeling, simulation, MPPT control

IV Photovoltaic systems

Issues, architectures, energy management (connected, isolated, storage, etc.)

Energy production, solar deposits, characterization, sizing, LCA

Grid-connected systems

Stand-alone systems

V Economic calculations: discount rate, inflation, IRR, LCOE, etc.

Support mechanisms: feed-in tariffs, additional remuneration.

Low-Power Hydroelectric Installations

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE36E
- **Open to exchange students:** Yes

Presentation

Description

Hydropower: different types of structures

Dams, their classification and monitoring

The different turbines and how to choose them according to the structure's characteristics

Hydrology of a development, water intake, inflow and outflow structures, turbines and available power, environmental impacts and mitigation measures. Regulations to be applied.

Organization and legislation of hydropower production in France, purchase obligation contracts.

Technical and economic pre-dimensioning of a power plant (BE).

Visit to the EDF Bazacle production site

GENERAL TRAINING

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE37
- **Open to exchange students:** Yes

List of courses

	Nature	CM	TD	TP	Crédits
Professional English-LV1-Semestre 9	Bloc				
Anglais Scientifique	Matière				
Choix 2 Anglais Professionnel - 3A	Choix				
Anglais Clinique	Matière				
Anglais de Cambridge ou Projet	Matière				
Themed Day: Energy and Sustainable Development	Matière				

Themed Day: Energy and Sustainable Development

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE37A
- **Open to exchange students:** Yes

Presentation

Objectives

Have a broad understanding of energy issues and the energy transition

Description

Beyond teaching about renewable energies (photovoltaic, wind, biogas, etc.), at the heart of our New Energy Technologies program, we want to give students a broader view of energy issues and challenges. To do this, we call on industry specialists in various fields. They give a one-day or half-day presentation, and students write a summary of the presentation, which is then assessed.

Examples of theme days:

JT: Energy transition challenges: Stephan Astier, Professor Emeritus, Toulouse INP

JT: PV: Brigitte Caoussat-Bonnans

JT: Microbial fuel cells

BASSEGUY Regine

JT: Microbial fuel cells

BASSEGUY Regine, CNRS

JT: CO2 capture processes

ALIX Pascal, IFPEN

JT: Nuclear energy

LATGE Christian, CEA

JT: Societal acceptability of renewable energies

VERVIER Philippe Acceptable Futures

JT: Industrial Ecology

Marianne Boix, Ludovic Montastruc

JT: Economic Aspects of Energy

LAFFORGUE Gilles, Toulouse Business School

JT: Economic Analysis of the Electricity Market

LEROYER Yoanne, Basque Country Community of Municipalities

JT: Biogas

PRIAROLLO Jeremie, Solagro

JT: Housing

CAPITAINE Loic, Ecozimut

We also visit industrial sites to illustrate the various lessons learned.

Wind and photovoltaic power production site in Ville Franche de Lauragais

Le Bazacle hydroelectric power production site in Toulouse

Smart ZAE SCLE INEO smart grid demonstration platform

Clerverts waste treatment and biogas production site, Organic'Vallée

Impact Entrepreneurship from Low to Deep Tech MF2E

ECTS
30 credits

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

In brief

- **Ametys Code:** M4SLJB39

List of courses

	Nature	CM	TD	TP	Crédits
Choix UE Hard Skills MF2E Parcours Impact Entrepreneurship	Bloc				
Choix UE Parc. MSN Parc. Impact Entrepreneurship	Choix				
MODELING	UE				5 credits
Models for Interfaces	Matière				
Modélisation de la turbulence	Matière				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
HIGH PERFORMANCE COMPUTING	UE				5 credits
Advanced Languages for programming	Matière				
Advanced Techniques for Scientific computing	Matière				
Meshing, Pre and Post Processing	Matière				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE				5 credits
Numerical methods for incompressible flows	Matière				
Numerical methods for compressible flows	Matière				
Data Assimilation	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				
Choix UE Parc. SEE Parc. Impact Entrepreneurship	Choix				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				
HYDROLOGY	UE				5 credits
The Hydrology of Transfers	Matière				
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				

Choix UE Hard Skills MF2E Parcours Impact Entrepreneurship

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

In brief

- **Ametys Code:** M297M1UP

List of courses

	Nature	CM	TD	TP	Crédits
Choix UE Parc. MSN Parc. Impact Entrepreneurship	Choix				
MODELING	UE				5 credits
Models for Interfaces	Matière				
Modélisation de la turbulence	Matière				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
HIGH PERFORMANCE COMPUTING	UE				5 credits
Advanced Languages for programming	Matière				
Advanced Techniques for Scientific computing	Matière				
Meshing, Pre and Post Processing	Matière				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE				5 credits
Numerical methods for incompressible flows	Matière				
Numerical methods for compressible flows	Matière				
Data Assimilation	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				
Choix UE Parc. SEE Parc. Impact Entrepreneurship	Choix				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				
HYDROLOGY	UE				5 credits
The Hydrology of Transfers	Matière				
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				

Choix UE Parc. MSN Parc. Impact Entrepreneurship

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

In brief

- **Ametys Code:** M297M1YO

List of courses

	Nature	CM	TD	TP	Crédits
MODELING	UE				5 credits
Models for Interfaces	Matière				
Modélisation de la turbulence	Matière				
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
HIGH PERFORMANCE COMPUTING	UE				5 credits
Advanced Languages for programming	Matière				
Advanced Techniques for Scientific computing	Matière				
Meshing, Pre and Post Processing	Matière				
PROJECT OF MODELING AND NUMERICAL SIMULATION	UE				5 credits
Numerical project for Compressible Flows	Matière				
Numerical project for Incompressible Flows	Matière				
Industrial codes	Matière				
NUMERICAL METHODS FOR SCIENTIFC CALCULATION IN AERODYNAMICS	UE				5 credits
Numerical methods for incompressible flows	Matière				
Numerical methods for compressible flows	Matière				
Data Assimilation	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				

Choix UE Parc. SEE Parc. Impact Entrepreneurship

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

In brief

- **Ametys Code:** M297M3UZ

List of courses

	Nature	CM	TD	TP	Crédits
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
ENVIRONMENTAL FLOWS	UE				5 credits
Atmospheric boundary layer	Matière				
Coastal Hydrodynamics	Matière				
Transport and Mixing	Matière				
BIG DATA AND GEOSCIENCES	UE				5 credits
Mathematical methods for exploiting data	Matière				
Using artificial intelligence for forecasting	Matière				
HYDROLOGY	UE				5 credits
The Hydrology of Transfers	Matière				
Hydrologie Approfondie : Bassin versant et Mil. Urb.(HABAMU)	Matière				
INSTALLATION AND WORKS	UE				5 credits
Soil mechanics	Matière				
Engineering of hydraulic works	Matière				
Impacts of industrial developments on the environment	Matière				
Risk and Prevention	Matière				
ADVANCED HYDRAULIC MODELING	UE				5 credits
Geographic Information System	Matière				
Advanced Free Surface Flow Modelling	Matière				
Sediment Transport and Morphodynamics	Matière				
Environmental numerical codes	Matière				
TRANSITION AND RENEWABLE ENERGIES	UE				5 credits
Energy transition and renewable energies	Matière				

Choix UE Parc. FEP Parc. Impact Entrepreneurship

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

In brief

- **Ametys Code:** M297M5FR

List of courses

	Nature	CM	TD	TP	Crédits
APPLICATION TO AERODYNAMICS	UE				5 credits
Aérodynamique	Matière				
Aéroacoustique	Matière				
Fluid Structure Interaction	Matière				
TURBULENCE AND MULTIPHASE FLOWS	UE				5 credits
Physics of incompressible turbulent flows	Matière				
Two phase flows	Matière				
Transfers in two-phase and turbulent media	Matière				
TRANSITION AND RENEWABLE ENERGIES	UE				5 credits
Energy transition and renewable energies	Matière				
HARMONISATION A7	UE				
Initiation Linux/Harm.A7	Matière				
Reminder of fluids mechanics and introduction to turbulence	Matière				
Dynamics of bubbles, drops and particles	Matière				
HARMONISATION N7	UE				
Material transfer	Matière				
Reactor sizing	Matière				
MULTIPHASE FLOWS PROCESSES	UE				5 credits
Two-phase flows with phase changes	Matière				
Two-phase hydraulics	Matière				
Coalescence Rupture Aggregation	Matière				
NUMERICAL SIMULATIONS - PROCESS	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Digital Disphasic	Matière				
Simulation of industrial flows	Matière				
Multiphysics coupling	Matière				
PROCESSES : PHYSICS AND MODELLING	UE				5 credits
Microfluidique	Matière				
Energy optimization of thermodynamic steam cycles	Matière				
Transfer in Porous media	Matière				
NUMERICAL SIMULATIONS - FLUID PARTICLES	UE				5 credits
Turbulence Models f/Stationary Numerical Simulations	Matière				
Simulation of industrial flows	Matière				
Simulation of a fluidised bed	Matière				
REACTIVE MEDIA	UE				5 credits
Combustion	Matière				
Piston engines Project	Matière				
ECOULEMENTS FLUIDE-PARTICULES	UE				5 credits
PhysicoChemical hydromatics : colloidal susp.	Matière				
Gas-particle flows	Matière				
Granular media	Matière				

SOFT SKILLS 1 - PARTNERSHIPS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M8AN
- **Open to exchange students:** No

Presentation

Description

Deepen your knowledge and skills in entrepreneurship, particularly through partnerships, as part of a low-tech or deep-tech project.

List of courses

	Nature	CM	TD	TP	Crédits
UT ou TBS ou TSM 1 - module 18h	Matière				
UT ou TBS ou TSM 2 - module 18h	Matière				
UT ou TBS ou TSM 3 - module 18h	Matière				

UT ou TBS ou TSM 1 - module 18h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M8FK

UT ou TBS ou TSM 2 - module 18h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M8JC

UT ou TBS ou TSM 3 - module 18h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M8NW

SOFT SKILLS 2 - DESIGN THINKING

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M985
- **Open to exchange students:** No

Presentation

Description

Deepen your knowledge and skills in entrepreneurship, particularly in design thinking, as part of a low-tech or deep-tech project.

List of courses

	Nature	CM	TD	TP	Crédits
Design Thinking 1 - module 15h	Matière				
Design Thinking 2 - module 18h	Matière				
Professional Communication and English - module 21h	Matière				

Design Thinking 1 - module 15h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M9C5

Design Thinking 2 - module 18h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M9GH

Professional Communication and English - module 21h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297M9KX

SOFT SKILLS 3 - PROJET DEEP TECH & APPLICATIONS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297MA45
- **Open to exchange students:** No

Presentation

Description

Deepen your knowledge and skills in entrepreneurship, particularly through some applications, as part of a low-tech or deep-tech project.

List of courses

	Nature	CM	TD	TP	Crédits
PDT & CU 1 - module 18h	Matière				
PDT & CU 2 - module 18h	Matière				
PDT & CU 3 - module 18h	Matière				

PDT & CU 1 - module 18h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297MA7R

PDT & CU 2 - module 18h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297MAC3

PDT & CU 3 - module 18h

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M297MAGH

Génie de l'Environnement (GE)

ECTS
30 credits

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

In brief

- **Ametys Code:** M4SMCQ6S

List of courses

	Nature	CM	TD	TP	Crédits
GE - Harmonisation	UE				2 credits
GE - Chimie des solutions	Élément constitutif				
GE - Hydraulique - Introduction à l'hydrologie	Élément constitutif				
GE - Agro-écosystèmes	Élément constitutif				
GE - SIG	Élément constitutif				
GE - Gestion de l'eau	UE				5 credits
GE - Gestion des déchets	UE				5 credits
GE - Industries et milieux naturels	UE				5 credits
GE - Economie circulaire	UE				5 credits
GE - Projet long	UE				4 credits
GE - Approfondissement	Bloc				4 credits
GE - Impacts Anthropiques	UE				4 credits
GE - Ingenierie de l'aménagement	UE				4 credits
GE - Ingenierie du développement soutenable	UE				4 credits

GE - Harmonisation

ECTS
2 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LIF5

List of courses

	Nature	CM	TD	TP	Crédits
GE - Chimie des solutions	Élément constitutif				
GE - Hydraulique - Introduction à l'hydrologie	Élément constitutif				
GE - Agro-écosystèmes	Élément constitutif				
GE - SIG	Élément constitutif				

GE - Chimie des solutions

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LIIZ

GE - Hydraulique - Introduction à l'hydrologie

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LIN8

GE - Agro-écosystèmes

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LIS4

GE - SIG

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LIWD

GE - Gestion de l'eau

ECTS
5 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LJJ2

GE - Gestion des déchets

ECTS
5 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LJN9

GE - Industries et milieux naturels

ECTS
5 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LJRS

GE - Economie circulaire

ECTS
5 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LJW6

GE - Projet long

ECTS
4 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LK03

GE - Approfondissement

ECTS
4 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LK4R

List of courses

	Nature	CM	TD	TP	Crédits
GE - Impacts Anthropiques	UE				4 credits
GE - Ingenierie de l'aménagement	UE				4 credits
GE - Ingenierie du développement soutenable	UE				4 credits

GE - Impacts Anthropiques

ECTS
4 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LK8K

GE - Ingenierie de l'aménagement

ECTS
4 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

> **Ametys Code:** M297LKCU

GE - Ingenierie du développement soutenable

ECTS
4 credits

Component
École Nationale Supérieure Agronomique de Toulouse

In brief

- **Ametys Code:** M297LKH6

PFE FISA

ECTS
30 credits

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

In brief

- **Ametys Code:** M4HQ9QDJ
- **Open to exchange students:** No

Presentation

Description

5-6 month end-of-studies project carried out at the company where the work-study program takes place.

PROJET FIN D'ETUDES MF2E SANS PROJET LONG

ECTS
30 credits

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

In brief

- **Ametys Code:** M4HQ9QIY

List of courses

	Nature	CM	TD	TP	Crédits
Stage 2A MF2E	Matière				6 credits
PFE MF2E sans PL	Module				24 credits

Stage 2A MF2E

ECTS
6 credits

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

In brief

- **Ametys Code:** M3XJX438
- **Open to exchange students:** No

Presentation

Description

8-weeks internship in a company or laboratory between the second and third years.

PFE MF2E sans PL

ECTS
24 credits

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

In brief

- **Ametys Code:** M4HQE0VR
- **Open to exchange students:** No

Presentation

Description

5- to 6-month end-of-studies project carried out in a company.

PFE MF2E avec PL

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N0EM02

List of courses

	Nature	CM	TD	TP	Crédits
PROJET LONG MF2E	Matière				8 credits
PROJET DE FIN D'ETUDE-MF2E	Matière				16 credits
Stage 2A MF2E	Matière				6 credits

PROJET LONG MF2E

ECTS
8 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N0EM02A
- **Open to exchange students:** No

Presentation

Description

A 6-week project in collaboration with an industrial company, in groups of 2 to 4 students, with the aim of solving the problem posed by the company.

This involves choosing and using a methodology (digital tools, laboratory experiments, field measurements, etc.) and a project management approach.

PROJET DE FIN D'ETUDE-MF2E

ECTS
16 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N0EM02B
- **Open to exchange students:** No

Presentation

Description

5- to 6-month end-of-studies project carried out in a company.

Stage 2A MF2E

ECTS
6 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4RA179I

SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S5-FISA

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AK06

List of courses

	Nature	CM	TD	TP	Crédits
Careers and Management 1	Matière				
Careers and Management 2	Matière				
Anglais Professionnel-S5-App	Matière				

Careers and Management 1

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AK06C
- **Open to exchange students:** No

Presentation

Objectives

Develop key professional competencies to communicate effectively, manage projects and work in international teams.

Description

1 semester of 12 weekly sessions aimed to develop your personal professional project.

Careers and Management 2

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AK06D
- **Open to exchange students:** No

Presentation

Objectives

Develop key professional competencies to communicate effectively, manage projects and work in international teams.

Description

1 semester of 12 weekly sessions aimed to develop your personal professional project.

Anglais Professionnel-S5-App

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AK06E
- **Open to exchange students:** No

Presentation

Objectives

Perform key oral and written workplace tasks in English.

Description

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

MATHEMATIQUES ET CALCUL SCIENTIFIQUE 1

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM01

List of courses

	Nature	CM	TD	TP	Crédits
Mathematics 1	Matière				
Scinetific calculation and Programming 1	Matière				

Mathematics 1

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM01A

Presentation

Objectives

The objective of the course is to introduce the basic concepts in mathematics that will be used for the modeling of engineering problems in fluid mechanics. Some additions on the program level bac +2 will be offered as tutored work (trigonometric functions, exponentials, linear forms, integrals Riemann ...).

Description

Program :
- complement of linear algebra
- differentiation and calculation of multiple integrals
- Fourier transformation
- distributions
- analytical functions

Scinetific calculation and Programming 1

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

> **Ametys Code:** N5AM01B

Presentation

Objectives

It is an introductory course in computer science for scientific computing. The objectives are for students in terms of knowledge and know-how :

- Get a culture on the history of computer science
- Know the most common computer architectures
- Understand what is a system, a language, a terminal, a file
- Learn basic BASH shell commands (no script)
- Learn about algorithmics to solve scientific problems
- Learn the basic commands of a structured language (fortran)
- Know how to make a library, modules and compile a set of objects (Makefile)
- Be able to understand the error messages provided by a compiler
- Being able to translate a problem (from mathematics, engineering, a model) into a functional, efficient and reusable computer program.
- Being able to understand and modify sources of code written by a stranger
- Maintain a critical mind over numerical results obtained in a code
- Learn how to use basic tools for scientific computing (draw curves, write a report, use a powerful text editor)
- Lead a project as a team.

Description

The teaching is presented by themes: history, introduction to computers, architectures, systems, languages and solving scientific problems (mathematics, structure, aerodynamics). The teaching consists of about 25% of courses, the rest being machine work and a long-term design office. Self-employment is also required.
All the course documents, or corrected exercises or practical work, as well as themed documents are available on Moodle to facilitate a remote work of the alternating students.
The teacher offers extremely varied exercises in all aspects of computer language: variables, table, structures, functions, input-output, modules and the structuring of a code (Makefile, library, modules).
It also shares many programming techniques to optimize the size of a code and make it modular, usable and editable by an unsuspecting user.
Awareness of free software and intellectual property (plagiarism) is also proposed.

The assessment is in the form of continuous monitoring, personal programs to be rendered, a test of knowledge on Moodle and the report (report + sources) of the Design Office.
A personal investment and a certain rigor are required to master at least the language and the techniques taught.

MECANIQUES DES MILIEUX CONTINUS

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM02

List of courses

	Nature	CM	TD	TP	Crédits
Mécanique des Milieux Continus	Matière				

Mécanique des Milieux Continus

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM02A

Presentation

Objectives

This course describes the kinematics of continuous media and the principles of conservation of mass, momentum and energy. It presents the properties of the stress tensor and the associated behavior laws.

Description

Kinematics of continuous media-deformation
Conservation laws of mass, momentum and energy.
Inequality of Clausius-Duhem
Stress tensor - constitutive law
Demonstration of the Navier-Stokes equation
Equation of sound

THERMODYNAMIQUE

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM03

List of courses

	Nature	CM	TD	TP	Crédits
Thermodynamics	Matière				

Thermodynamics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM03A
- **Open to exchange students:** No

Presentation

Objectives

Learn to use the first two principles of thermodynamics to carry out energy balances on conventional installations (turbines, compressors, boilers, refrigeration machines, motors, etc.).

Description

This course covers the basics of classical thermodynamics, including the first two principles, equation-of-state formulations and the use of thermodynamic potentials, simple models of single-component systems, phase changes and moist air.

Translated with DeepL.com (free version)

SIGNAUX ET SYSTEMES

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM04

List of courses

	Nature	CM	TD	TP	Crédits
Systems and Signals	Matière				

Systems and Signals

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N5AM04A

Presentation

Objectives

The objective is to acquire tools of the engineer in deterministic signal processing and automatic continuous time, for a first approach of the main aspects related to the mechanical vibrations in an industrial context: the modeling, the measurement, the control. Localized parameter modeling (lumped parameters) is preferred.

Description

The module consists of two parts:
I Modal Experimental Analysis (4 CM, 6TD, 1TP):

- SLI Model Linear Invariant System
- Introduction to the concepts of organization and interaction.
- Frequency Response Function (F.R.F).
- Oscillatory and aperiodic mode. Stability.
- Convolution property. Memory effect.
- Filtering (RII, RIF).
- Introduction to the signal concept (Fourier analysis)
- Digital identification techniques

1. Consequences of temporal truncation (spectral leakage, resolution)
2. Time Sampling Effects (Spectral Folding, Shannon's Th.)

3. Discrete TF (reciprocal Shannon th)

TP Modal Experimental Analysis: Modal identification (impact hammer) and detection of defects of a rotating machine (real-time monitoring by Simulink RTW, problem of starting and stopping machine). Resonance and anti-resonance of a 2 ddl system.

II APP Vibrations Under Control (project by team)

Through Project Based Learning, students acquire basic concepts and knowledge to control a hydromechanical process. The learning objectives are as follows:

- The concept of system to represent a physical process.
- Knowing how to translate the organization (the natural or artificial interactions) of a system by a recursive functional diagram (looped).
- To be able to translate the phenomena of his specialty, by associations of elementary models: Inertial effect, Resistive, Capacitive.
- Identify a basic hydromechanical process by analyzing the response to a deterministic solicitation (behavior model)
- Linearize a nonlinear model around an operating point to obtain a model L.T.I. (Linear Invariant System) in transfer.
- Determine the stability of a system controlled by the Nyquist criterion.
- Understand the risks of looped architecture (influence of phase delays on stability).
- Understand the interest of the looped architecture for performance (for stability, to manage disturbances).
- Know how to adapt a Proportional controller taking into account the antagonisms between performances (stability / precision, speed / sensitivity to noise).

FORMATION ENTREPRISE-S5 (App.)

ECTS
10 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N5AM05
- **Open to exchange students:** No

Presentation

Description

Teaching unit corresponding to periods spent at the company.

SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S6-FISA

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AK06

List of courses

	Nature	CM	TD	TP	Crédits
Anglais Professionnel-S6-FISA	Matière				
Careers and Management 1	Matière				
Careers and Management 2	Matière				

Anglais Professionnel-S6-FISA

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AK06B
- **Open to exchange students:** No

Presentation

Objectives

Develop your professional communication skills by performing routine written and oral communication tasks in English.

Description

One semester of 12 interactive weekly sessions.

Careers and Management 1

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4RA357R

Careers and Management 2

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4RA35DY

MATHEMATIQUES ET CALCUL SCIENTIFIQUE 2

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM01

List of courses

	Nature	CM	TD	TP	Crédits
Mathematics 2	Matière				
Scientific calculation and programming 2	Matière				

Mathematics 2

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM01A

Presentation

Objectives

This course is divided into two parts:
- the first part focuses on differential systems (EDO / SDO) and linear partial differential equations (PDE); the student will have to become familiar with these objects which are at the heart of the modeling of mechanical systems.
- the second part deals with the modeling of random phenomena: the objective is to allow the student to carry out basic calculations on univariate and bivariate random variables, to put into practice the tools of statistics, and to estimate laws of probability.

Description

Part 1:
- 1st and 2nd order ODE, linear ODS, representation of solutions, critical points, stability, phase portrait
- 1st and 2nd order linear PDEs (parabolic, hyperbolic, elliptic)
- Problems in unbounded domains: FT method, feature method, complex potential method
- Problems in bounded domains: boundary conditions, method of separation of variables

Part 2 :
- Elements of calculation of probabilities
- Random variables
- Couple of random variables
- Calculation of probability law by transformation of v.a.
- Elements of statistics

- Adjustment of probability laws

Pre-requisites

Mathematics 1

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

TOULOUSE INP N7

Scientific calculation and programming 2

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM01B

Presentation

Objectives

Knowing how to write a numerical scheme for partial differential equations of the advection diffusion type with finite difference and finite volume methods.

Description

6 Lessons

6 Turorials

12 machine work

MECANIQUE DES FLUIDES 1

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM02

List of courses

	Nature	CM	TD	TP	Crédits
Mécanique des Fluides 1	Matière				

Mécanique des Fluides 1

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM02A

Presentation

Objectives

Small Re

The object of this course is to describe the particular hydrodynamic phenomena that one encounters with small Reynolds numbers . The basic equations are commented, analyzed and solved in simple geometries.

Description

Small Re

Introduction: Re << 1 What is inertia? and applications
Basic equations and different formulations
Specific properties (linearity, reversibility, reciprocity) and consequences.
Fundamental Solutions of Stokes Equations
Cellule of Hele-Shaw
Lubrication (hydraulic bearing)
Flows in thin layers
Calculation of the stokes force

THERMIQUE 1

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM03

List of courses

	Nature	CM	TD	TP	Crédits
Thermique 1	Matière				

Thermique 1

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM03A
- **Open to exchange students:** No

Presentation

Description

This course aims to provide students with a basic understanding of thermodynamics (conduction, convection, radiation).

HYDRAULIQUE

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM04

List of courses

	Nature	CM	TD	TP	Crédits
Hydraulique	Matière				

Hydraulique

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM04A

Presentation

Objectives

Basic concepts of steady-state or transient unidirectional flows

Introduction to usual softwares

Description

Pipe flows:

- General principles of hydraulics
- Definition of a pressure flow systems
- Flow regimes
- Notions of linear / singular head losses
- Pipeline networks
- Pumps and turbines

Open channel flow:

- Engineering problems of free surface flows
- Stationary flow
- Hydraulic structures and singularities

- Equations of Saint-Venant
- Numerical modeling

Useful info

Contacts

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FORMATION ENTREPRISE - S6 (App.)

ECTS
10 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N6AM05
- **Open to exchange students:** No

Presentation

Description

Teaching unit corresponding to periods spent at the company.

MECANIQUE DES FLUIDES 2

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM01

List of courses

	Nature	CM	TD	TP	Crédits
Boundary layer	Matière				
Compressible	Matière				

Boundary layer

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM01A
- **Open to exchange students:** No

Presentation

Objectives

Introduction to asymptotic calculation methods (perfect fluid, boundary layers) and analytical resolution of simple laminar flow problems. Wall transfer analysis (momentum, heat flow, mass transfer)

Description

Review of perfect fluid flow
Dynamic, mass and thermal laminar boundary layers
- Localization of viscous effects in real fluid flows at high Reynolds numbers: advection-diffusion balance
- Characteristic boundary layer parameters: thickness, wall transfer
- Local equations of the isovolume dynamic boundary layer: Prandtl model - detachments
- Integral equations and global balances in isovolume evolution: von Karman equations

Methods and examples for calculating boundary layer flows
- Solving local equations
- Calculation by integral method: von Karman-Polhausen equations.

Half of the course is devoted to practical exercises.

Compressible

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM01B

Presentation

Objectives

At the end of this course students will be able to:
- To explain the concept of compressibility qualitatively and quantitatively.
- Know the equations involved in a classical problem of compressible fluid mechanics.
- Know how to identify the different fields of application of compressible fluid mechanics.
- Understand the physical mechanisms causing a shock wave.
- Understand the physical mechanisms at the origin of a relaxation wave.
- Know how to write conservation equations through a one-dimensional shock wave.
- Know how to exploit the one-dimensional shock tables.
- Being able to apply the methodology for dealing with a problem involving oblique shock waves (use of tables).
- Being able to apply the methodology to deal with a problem involving relaxation waves (use of tables).
- To know how to find Hugoniot's relation in the case of quasi-one-dimensional flows.
- To know the reasoning allowing to find the different modes of operation of a nozzle of Laval.

Description

This teaching will be broken down into 10 sessions of tutorial-courses.

SYSTEMES ET FLUIDES COMPLEXES

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM03

List of courses

	Nature	CM	TD	TP	Crédits
Systems and Complex Fluids	Matière				

Systems and Complex Fluids

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM03A

Presentation

Objectives

The objective of the module is to understand the complexity of flows due to:

- rheological properties of the fluid
- interactions with the environment

Four examples are developed:

1. Hydraulic transmission
2. Vibrations under Turbulent flows
3. Porous media
4. Complex Fluids

Description

Hydraulic Transmission: Study of a "Servo-Hydraulic-Actuator"

- Hydraulic Modeling and Control
- Influence of compressibility on performance
- Mechatronic simulation

Vibrations Under Turbulent Flows: Study of aeroelastic interactions (lock-in, flutter)

- Spectral and correlation analysis "real time" vibrations of a flexible structure in a turbulent flow (Welch periodogram)

- Identification of aeroelastic coupling by filtering relations (Wiener-Lee)

Porous media

Complex Fluids

THERMIQUE 2

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM04

List of courses

	Nature	CM	TD	TP	Crédits
Thermique 2	Matière				

Thermique 2

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM04A
- **Open to exchange students:** No

Presentation

Description

In-depth study of thermal concepts relating to:

- Heat exchangers
- Heat transfer with phase change
- Radiation.

MECANIQUES DES FLUIDES 3

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM01

List of courses

	Nature	CM	TD	TP	Crédits
Mécanique des Fluides 3	Matière				

Mécanique des Fluides 3

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM01A

Presentation

Objectives

- Presentation of classical methods of treatment and resolution of turbulent flows
- Introduction of the concept of turbulent viscosity and the associated assumptions and limitations
- Application to cases of canonical turbulent flow (jet, boundary layer ...)
- Phenomenological introduction of turbulent field statistics (multi-point time statistics) and aspects of dispersion and mixing by turbulent flows
- Opening on the different numerical simulation strategies of turbulent flows.

Description

- 9 courses
- 6 TD
- 2 TP computer
- 2 experimental labs
- 1 exam

Introduction to turbulent flow
1- Introduction
2- derivation of Reynolds equations
3- Free shear flows (jets, wakes, layer of mixtures)
4- Wall flows (boundary layers, pipes)

5- Turbulent mixing and natural convection
6- Structure of the turbulence

Pre-requisites

- Basis on Mechanics of continuous media and fluid mechanics (notion of constraints, Navier-Stokes equations)
- Concepts of statistics and signal processing (moment, correlation, spectrum, distribution function)

FORMATION ENTREPRISE-S7 (App.)

ECTS
10 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM05
- **Open to exchange students:** No

Presentation

Description

Teaching unit corresponding to periods spent in the company.

SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S7-FISA

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AK06

List of courses

	Nature	CM	TD	TP	Crédits
Anglais Professionnel-S7-App	Matière				
Careers and Management 1- App Sem7	Matière				
Careers and Management 2- APP Sem7	Matière				

Anglais Professionnel-S7-App

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AK06A
- **Open to exchange students:** No

Presentation

Objectives

Develop your professional communication skills by performing routine written and oral communication tasks in English.

Description

1 semester of 12 interactive weekly sessions.

Careers and Management 1- App Sem7

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AK06D

Careers and Management 2- APP Sem7

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AK06E
- **Open to exchange students:** No

Presentation

Objectives

Develop key professional competencies to communicate effectively, manage projects and work in international teams.

Description

1 semester of 12 weekly sessions aimed to develop your personal professional project.

MECANIQUE ET MACHINES

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM07

List of courses

	Nature	CM	TD	TP	Crédits
Mécanique des Solides et Structures - S8	Matière				
Machine Thermodynamics	Matière				

Mécanique des Solides et Structures - S8

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM02A

Machine Thermodynamics

Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N8AM03A

Presentation

Objectives

The purpose of this course is to apply the 1st year thermodynamics course to non-condensable gas cycle machines.

Description

The first lesson is dedicated to thermodynamic reminders of open machines. The thermodynamics of machines is applied to the study of gas turbines and turbojets (3 sessions). The optimization of the machine cycles is treated with the ThermOptim software (6 sessions). This software will also be used in the 3rd year in the "Thermal Machines" module (3A / MOST)

TRANSFERTS EN MILIEUX NATURELS

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM04

List of courses

	Nature	CM	TD	TP	Crédits
Tranfert en Milieux Naturels	Matière				

Tranfert en Milieux Naturels

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM04A

PROJET

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

> **Ametys Code:** N8AM08

List of courses

	Nature	CM	TD	TP	Crédits
Projet Industriel	Matière				
Projet Ecole	Matière				

Projet Industriel

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM08A

Projet Ecole

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AM08B

ELASTICITE-PLASTICITE

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N7AM02

List of courses

	Nature	CM	TD	TP	Crédits
Elasticity Plasticity	Matière				

Elasticity Plasticity

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **plugin.odf-inp:PLUGINS_ODF_COURSE_NBHOURS_TXT:** 46
- **Ametys Code:** N7AM02A
- **Open to exchange students:** No

Presentation

Objectives

Study and modeling of the elastic mechanical behavior of solid materials

Description

Constitutive law of an isotropic homogeneous linear elastic solid.
Demonstration of the Navier-Lamé and Beltrami equations
Case of plane deformations and plane stress - Airy function
Study of the typical cases of elasticity: traction, shear, bending, torsion.
introduction to plasticity
2 Practical Work

Pre-requisites

Continuous mechanics

SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S8-FISA

ECTS
4 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AK06

List of courses

	Nature	CM	TD	TP	Crédits
Anglais Professionnel-S8-App	Matière				
Careers and Management 1	Matière				
Careers and Management 2	Matière				

Anglais Professionnel-S8-App

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N8AK06A
- **Open to exchange students:** No

Presentation

Objectives

Develop your professional communication skills by performing routine written and oral communication tasks in English.

Description

1 semester of 12 interactive weekly sessions.

Careers and Management 1

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4RA3IUS

Careers and Management 2

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** M4RA3J05