Academic Exchange possibilities with the Ecole Centrale de Lyon

1. The Engineering Science programme at the Ecole Centrale de Lyon

The basic teaching programme at the ECL is a three year taught degree in Engineering Science. Students usually spend two years post-baccalaureat (post-18) in *Classes Préparatoires*, offered by selected *lycées*, preparing for the competitive entrance exam for the major engineering schools, and during this time they study essentially maths and physics. Once admitted to the ECL, students begin with 18 months of the common core curriculum, in which they study all the main engineering science disciplines, and then, for the remaining 18 months, they can specialise, to some extent.

Teaching at the ECL is organised in semesters; to take account of the preceding two years of *Classes Préparatoires,* the two semesters of the first year are denoted S5 and S6, those of our second year S7 and S8, and those of the final year S9 and S10. The academic year (S5, S7, S9) starts at the beginning of September, and the semesters S6 and S8 start at the beginning of February. S10, the second semester of the final year, starts later, at the beginning of April.

There are therefore 3 main blocks of courses in the Engineering Science programme:

- The core curriculum – Semesters S5, S6 and S7 (see Appendix A)
- A semester of optional courses – Semester S8 (see Appendix B)
- A year of specialization – Semesters S9 and S10 (see Appendix C)

Each semester is worth 30 ECTS.

As can be seen in Appendix A, subject teaching is done in a single unit, so there is no imposed order in which the courses are taken. Consequently, the teaching programme does not fully comply with the European LMD (3-5-8) scheme, and is essentially a 2-4-5-8 structure, in which the first two years at the Ecole Centrale are equivalent to the final year of a Bachelor degree *and* the first year of a 2-year Master's degree, but mixed in together. The final year (S9 and S10) is then equivalent to the final year of a 2-year Master's programme, and the Engineering degree is considered equivalent to a Masters degree.

2. Masters programmes at the Ecole Centrale de Lyon

In France the engineering degree is considered equivalent to a Masters degree, but it is not the same as a Masters degree; the engineering degree in France confers certain rights and advantages (higher salaries, posts that are reserved for graduates with an engineering degree, sometimes even from a particular Grande Ecole….) whilst, in some situations, a doctoral school might require that all candidates hold a Masters degree. So the Ecole Centrale also offers a range of Masters degrees, including three international programmes that are taught entirely in English. The full list is provided in Appendix D.

Masters programmes in France usually last 2 years; most of the Masters programmes at the Ecole Centrale are offered in collaboration with other higher educational establishments in Lyon and St Etienne, and at the moment the Ecole Centrale only offers courses for the second year of these Programmes (M2). But this is changing, and the Ecole Centrale will open an additional 3 International Masters programmes (to be taught entirely in English) in September 2022.

Some final year engineering students at the Ecole Centrale also take, in parallel, the M2 courses from one of the Masters programmes, and obtain – if successful – the corresponding Masters degree as well as the engineering degree. This is possible because the vast majority of the M2 courses are shared with the final year Engineering programme at the ECL

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3. Exchange programmes for incoming students

3.1 The S8 semester (30 ECTS)

The S8 semester runs from the beginning of February until the middle of July. Students take 5 courses from a choice of about 60 (arranged, for timetabling purposes in 6 blocks). The subjects offered in S8 change a little every year, but the programme for 2020-21 is provided in Appendix B. About a third of the courses are offered in English, and this proportion is slowly increasing every year. We would consider the academic level of these courses to be equivalent to M1.

The taught courses finish at the end of April, and are worth 15ECTS; students obtain the remaining 15ECTS from language courses and an extended, full-time research project in one of our laboratories, from May until the end of June. The research project can be conducted entirely in English.

We aim to offer incoming S8 students a room on campus, but we cannot always guarantee this.

3.2 The Diplôme d'Etudes Supérieures de l'Ecole Centrale de Lyon (DESECL) (60 ECTS)

The DESECL is a *Diplôme d'établissement* awarded to students who have successfully completed the entire final year programme. Students taking this programme follow all the taught courses in S9:

- A Métier
- An Option
- 2 Modules Ouverts Métier
- 6 Modules Ouverts Disciplinaires
- 3 Modules Ouverts Sectoriels

and the extended internship in S10, which can be done either in one the laboratories of the Ecole Centrale, or in a research laboratory elsewhere, or in a company. By law, internships in commercial companies in France must be salaried. The internship is evaluated on the basis of a written report and an oral examination in front of a jury.

The S9 semester runs from the beginning of September to the end of March, and the S10 semester runs from the beginning of April until the middle of September (at the latest). Each semester is worth 30 ECTS.

It is potentially possible for a non-francophone student to complete the year without any teaching in French, but the choice of courses open to the student will be very limited. This is changing gradually, but the introduction of Masters programmes in English over the coming years is likely to accelerate this change.

We offer accommodation on campus to all international students registering for the full year, even if they subsequently do their internship elsewhere.

3.3 Masters programmes

3.3.1 M2 Master (60 ECTS)

Students with an academic level judged equivalent to the 1st year of a Masters programme can apply for admission to the second year of a Masters programme. Admission is decided by the admissions committee for each Master, not by the Commission for University Exchanges.

The Masters programmes consist of two semesters – S9 and S10 – with taught courses in S9 and a research project or internship in S10. The S9 semester runs from the beginning of September to the end of March and the S10 semester runs from the beginning of April until the middle of September (at the latest). Each semester is worth 30 ECTS.

The final project or internship is evaluated on the basis of a report and an oral examination in front of a jury. By law, internships in commercial companies must be salaried.

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3.3.2 M1 Master (60ECTS)

The International Masters degrees offer a two year programme (M1, M2) taught entirely in English; for some of the Masters programmes it is possible for an international exchange student to enrol in the M1 programme for credits (60ECTS). Candidates should expect to have attained a level judged equivalent to the final year of a Bachelor degree before starting the course. Admission is decided by the admissions committee for each Master, not by the Commission for University Exchanges.

3.4 Certificat de Formation à la Recherche (30 or 60 ECTS)

The *Certificat de Formation à la Recherche* (Certificate in Research Training) is a *Diplôme d'Etablissement* which can last either one (30 ECTS) or two semesters (60ECTS). The essential element of the programme is an extended research project carried out in one of the laboratories on campus. For the full year programme, it is possible to do two different research projects, each for one semester. Students who are not French-speaking take lessons in French as a Foreign language, provided by the ECL.

Students can also attend any of the taught courses from the 3 year engineering programme, either as auditors or for credits.

In some cases it is possible for students on the 2 semester programme to do an extended research project in which the first semester of research is performed in one of the laboratories on campus and the second semester is performed as a paid internship with an industrial partner. In this case, the student must take 100 hours of taught courses in the first semester, in parallel with the research project, in order to qualify as an intern, under French employment law.

The *Certificat de Formation à la Recherche* is evaluated on the basis of a written report and an oral examination in front of a jury. Where possible, a member of the teaching staff from the home university is included in this examination jury.

The entire programme can be conducted in English, since all the research groups at the Ecole Centrale de Lyon speak English; the final report can be written in English, and the oral exam can be held in English.

Students registered for the CFR will be offered a room on campus.

3.5 Double Degree 1-2 (120 ECTS)

The *Double Degree 1-2* offers students the possibility to study the core curriculum (S5, S6, S7 & S8) together with the associated internships for the two years, and obtain the *Diplôme d'Ingénieur de l'Ecole Centrale de Lyon.* It is only open to students from establishments with whom we have a specific Double Degree agreement; this is because the programme in each establishment validates part of the engineering degree programme in the other establishment. The degrees from both establishments are awarded at the end of the combined programme – it is necessary for the student to validate the programme in *both* establishments in order to obtain the two degrees.

Students registered for the DD1-2 will be offered accommodation on campus for the two years.

3.6 Double Degree 2-3 (120 ECTS)

The *Double Degree 2-3* offers students the possibility to study part of the core curriculum (S5 *or* S7 followed by S6 *or* S8) and then the final year (S9 and S10), together with the associated internships for the two years, and obtain the *Diplôme d'Ingénieur de l'Ecole Centrale de Lyon.* It is only open to students from establishments with whom we have a specific Double Degree agreement; this is because the programme in each establishment validates part of the engineering degree programme in the other establishment. The degrees from both establishments are awarded at the end of the combined programme – it is necessary for the student to validate the programme in *both* establishments in order to obtain the two degrees.

The choice of semesters for the first year (S5 *or* S7 followed by S6 *or* S8) will be made jointly by the student, the student's home establishment and the Ecole Centrale de Lyon. When registering for the DD2-3 it will

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not be possible to select the *Option* and *Métier* for the final year – students will apply for admission to these during their first year at the Ecole Centrale de Lyon, along with all the other students, and they will follow the same selection process.

Students registered for the DD2-3 will be offered accommodation on campus for the two years.

3.7 Extended Programme with an additional sabbatical term

Students from countries with a staggered academic year (essentially those in the Southern hemisphere) and registered for one of the academic exchange programmes, can extend their stay in France by doing an additional internship (i.e. from September until February). But because this is a new academic year in France:

- Students must register at the Ecole Centrale de Lyon for an additional year
- To qualify for the status of intern, they must follow a minimum of 100 hours of courses in the academic year (this is a requirement of French employment law).

Consequently:

1. The sabbatical term option **must** be included in the exchange agreement with the home establishment, otherwise, by law, we must charge full registration fees for this additional year.
2. To meet the obligation of 100 hours of taught courses, students usually register for online courses with the CNAM, at a cost of approximately 600€. This fee must be paid by the student, and will not be covered by any agreement between the Ecole Centrale de Lyon and the home institution.

3.8 Masters thesis (30 ECTS)

In some situations it may be possible for a student registered for a Masters degree in their home institution to perform the research for their Master's thesis in one of the laboratories at the Ecole Centrale de Lyon, without paying bench fees.
For this to be possible:

1. The programme should be declared in the exchange agreement with the home institution
2. The student should have the agreement of a research supervisor in a laboratory at the Ecole Centrale de Lyon
3. The student will have to register for the *Certificat de Formation à la Recherche* and meet all the requirements of that programme. This is imperative, in order to comply with French employment law concerning internships. The production of a final report, and the accompanying oral exam are essential parts of this programme, and cannot be dispensed with.

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Appendix A – The Core Curriculum

Semester 5

Beginning of September – end of January

Group A	Group B
Electrical and control engineering	Information technology
Fluid mechanics and thermodynamics	Computer science
Mathematics	Mathematics
Economics and management	Economics and management

Engineering profession – project, site visits, sport, professional interviews
Languages – choice of 9

Semester 6

Beginning of February – end of June

Group A	Group B
Mechanical engineering	Materials science
Solid mechanics and structural engineering	Physics of materials
Information technology	Electrical and control engineering
Computer science	Fluid mechanics and thermodynamics

Engineering profession – project, site visits, sport, professional interviews
Languages – choice of 9

Semester 7

Beginning of September – end of January

Group A	Group B
Materials science	Mechanical engineering
Physics of materials	Solid mechanics and structural engineering
Social sciences	Social sciences

Specialization – 2 advanced courses from a choice of 32

Engineering profession – project, site visits, sport, professional interviews
Languages – choice of 9

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Semester 7 – Specialization courses

Group 1	Group 2
Power electronics	Multibody mechanical systems
Electromechanical conversion	Mechanical engineering
Non-linear control engineering	Vibration analysis
Multi-sensor, multi-actuator control	Inelastic behaviour of structures
Multimedia – concepts and technologies	Material damage and failure
Algorithms for problem solving	Materials and innovative surface treatments
Concurrent distributed applications in Java	Amorphous materials for innovative structures
Data analysis and pattern recognition	Biomechanics of living tissues and joints
Probability theory and random processes	Turbulence and instability
Deterministic and probabilistic methods for PDE's	Acoustics and waves in fluids
Numerical methods for ODE's and PDE's	Supersonic flows
Mathematical statistics and econometrics	Combustion and thermodynamics
Embedded systems architecture	Quantum mechanics and applications
Optimal filtering and information transmission	Molecular and supramolecular chemistry
Architectures for computing and data processing	Electrochemistry and chemitronics
Smart sensor networks: interface systems	Semiconductor solid-state physics

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Appendix B – S8 courses

Group A
Finite Element Method
GUI programming in C++
Life, information and systems
Numerical methods for mechanics
Mechanical metamaterials
Mechanics of thin structures
Rotor dynamics
Optics and photonics
Issues in sustainable development

Group B
Functional analysis
Collaborative algorithms and applications
Non-destructive testing
Nuclear engineering
Health engineering
Development of technological products
Design of sustainable packaging
Political sociology

Group C
Mathematical biology
Interactive design and Fablab practices
Image sensing and processing
Multiphysics simulation in mechanical design
Observation and analysis of materials
Microwave circuitry
Fundamental soil mechanics
Philosophy of science and technology
Corporate finance
Introduction to meteorology and oceanography

Group D
Webapps
Adaptive filtering – active noise control
PLM – Digital mockup
Physics and chemistry of surfaces and interfaces
Ecology and environment
Introduction to random vibrations
Two phase flow in energy systems
Wind turbines
Space physics and solar-terrestrial coupling
Interpersonal communication and professional practices
Machine learning

Group E
Algorithms and reasoning
Surfaces, friction, vibrations
From microscale to macroscale in mechanics
Selection of materials
Aircraft turbojets
Industrial process engineering
Globalization and transculturalities
Collaborate and manage in the era of digital technologies

Group F
Order within chaos
Insulating materials for electrical engineering
Intelligent mecatronic systems
Musical acoustics
Antenna, signals and processors
Society and its waste
Polymers, physical properties and innovation
Optimal design and computational fluid mechanics
Entrepreneurship and innovation
Financial markets
Probability theory and random processes

Courses in bold are taught in English

Each course consists of 32 taught hours, organised in 8 blocks of 4 hours.

The list of courses offered in S8 varies each year – this is the list for 2021-22. Full details of the courses will shortly be available on the internet.

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Appendix C The final year programme at the Ecole Centrale de Lyon

Students must take:

- A Métier
- An Option
- 2 Modules Ouverts Métier
- 6 Modules Ouverts Disciplinaires
- 3 Modules Ouverts Sectoriels

C.1 The Métiers

Students choose one of 6 Métiers:

- Consultant
- Research and Development
- Logistics and Supply Chain
- Eco-design
- Entrepreneur & intrapreneur
- Environmental and Technological Risk Management

Each Métier consists of 92 taught hours plus 30h of project work. The teaching is programmed between September and November.

C.2 The Options

Students choose one of 7 Options

- Aeronautics (*Aéronautique*)
- Bio-engineering and Nanotechnology (*Bio-Ingénierie et Nanotechnologies*)
- Energy (*Energie*)
- Information science and technology (*Informatique*)
- Mathematics and strategy (*Mathématiques et Décision*)
- Sustainable environment (*Transition Ecologique et Territoires*)
- Transportation engineering (*Transport et Trafic*)

Each option consists of 50 taught hours and 80 hours of project work. The option is timetabled for the period January- end of March.

C.3 Modules Ouverts Métiers

Students must choose 2 – one may be imposed by the choice of Métier

Group A	Group B
Engineered systems	Quality assurance
Industrial management	Economic intelligence and intellectual property
Industrial and commercial law	Human resources
	Environmental hazards

Each course consists of 14 hours of lectures.
Courses in bold are taught in English.

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C.4 Modules Ouverts Disciplinaires

Students must choose 6 – one may be imposed by the choice of Option

Group A
Computational Fluid Dynamics
Big data challenges
Elastic waves
Green computing
Human physiology and biotechnology
Nanotechnologies
Information systems for business
Fluid-structure interaction

Group B
Fundamentals of turbomachinery
Ocean and coastal engineering
Deep learning and Artifical Intelligence
Energy storage and conversion
Uncertainties and heterogeneities in structures
Soft matter: nanosystems and biological interfaces
Machine learning and data mining
Stochastic processes
Composite materials and structures

Group C
Nanophotonics
Statistics for engineering science
Secure embedded systems
Combustion
Processing and analysis of audio and video data
Durability of materials and structures
Introduction to acoustics
River hydraulics
Stability of mechanical systems
Electric power systems

Group D
The physics of turbulence
Power plant turbine technology
System identification and sparse decomposition
Operational research
Construction materials
Autonomous microsystems
Structural dynamics
Handling structured data
Material behaviour
Variational methods for PDE's

Group E
Introduction to non-linear vibrations
Diagnosis and system health monitoring
Mechanical assembly: architecture and geometry
Tribology
Climate change and geo-engineering
Aerodynamic noise
Physics for Information Technology
Computer networks
Engineering of a mass-produced object

Group F
Environmental acoustics
Ground investigation
Advanced control engineering
Database systems
External aerodynamics
Dynamics of biological human systems
Characterisation of surfaces and nanostructures
Nuclear Energy
Numerical methods for PDE's

Courses in bold are taught in English

Each course consists of 16 hours of lectures and 12 hours of practical work. These courses are timetabled from the middle of September until the end of December.

This list of courses is the programme that will be offered in 2021-22; the programme changes a little each year. Full details of the courses will shortly be available on the internet.

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C.4 Modules Ouverts Sectoriels

Students must choose 3 – one may be imposed by the choice of Option. Students choose these courses in December of the final year.

Group A
Transonic aerodynamics
Algorithms for decision making
Electromagnetic compatibility
Hydrology and hydrogeology
Geotechnical engineering
Tissue engineering and biomaterials
Stability of rotating machines
Intrapreneur

Group B
Transportation noise
Computer graphics
Design of installations for power generation
Atmospheric pollution
Strategic management
Structural and system health monitoring

Group C
Advanced vehicle dynamics
Material selection and composites
Hybrid vehicles
Managing business I.T. systems
Physical problems in unbounded media
Microsystems, bio-sensors and micro-fluidics
Civil engineering works
Start-up creation

Group D
Active control of noise and vibration
Macro energy
Traffic modelling and management
Information technology
Complex phenomena in structural dynamics

Group E
Functionalized thin layers and surfaces
Dynamics of mechanisms
Unsteady flows in turbomachinery
Management of natural resources
Interactive data visualisation
Time series econometrics
Energy and environmental impact

Courses in bold are taught in English
Each course consists of 28 taught hours, organised in 7 blocks of 4 hours.
The courses are timetabled from January until the middle of March.

This list of courses is the programme that will be offered in 2021-22; the programme changes a little each year. Full details of the courses will soon be available on the internet.

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Appendix D Masters Programmes

In France a Masters programme usually lasts 2 years (M1 & M2) and may have several specializations (*parcours*). The Ecole Centrale de Lyon offers a range of Masters programmes, usually in collaboration with other establishments in Lyon and St Etienne; for most of the Masters programmes, the ECL only offers some of the specializations in each Master, and only at the M2 level. Currently (2021-22), much of the teaching in the Masters programmes is in French, but this is changing.

From September 2022 the ECL will be offering 6 International Masters programmes taught entirely in English.

Admissions to the Masters programmes are decided by the admissions committee for each programme.

Students can only be exempted from registration fees for the Masters programme if this option has been included in the exchange agreement with the home institution.

D.1 International Masters Programmes

The programmes cover the two years of a standard French Masters degree (M1 and M2) but students who have already attained the M1 level can be admitted directly to the second year (M2) at the discretion of the admissions committee for the Master.

- Acoustics (jointly with the University of Adelaide, Australia)
- Aerospace (jointly with the Technical University, Darmstadt)
    - *Aeronautical and spacecraft propulsion*
    - *Aerostructures*
- Materials Science and Engineering (M1 opening in September 2022)
    - *Biomimicry and Surface Engineering (BIOSURF)*
- Nanoscale engineering (with Lyon 1 and INSA)
- Atmosphere, Ocean and Climate Science (with Lyon 1) (M1 opening in September 2022)
    - *Atmospheric Science*
    - *Ocean Science*
    - *Climate Science*
- Environmental Risk (RisE)
    - *Water & Wind Engineering (M1 opening in September 2022)*
      (with INSA Lyon, Politecnico di Torino , Università di Genoa, Karlsruhe Institute of Technology, University of Surrey, Budapest University of Technology and Economics)

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D.2 French Masters Programmes

These programmes are taught mainly in French, and the ECL only accepts students for the 2nd year (M2) for some of the specializations. In general, these specializations are taught in collaboration with other establishments, and students should expect to have some of their teaching on other campuses in Lyon.

- Chemistry and Materials Science
  - *Innovative materials for health, transport and energy*
- Civil Engineering
  - *Advanced modelling and experimentation in civil engineering (MEAGC)*
  - *Materials and Structures for Sustainable Construction (MSDC)*
- Computer Science
  - *Data science*
  - *Artificial intelligence*
  - *Image processing*
  - *Information Technology and the Internet*
  - *Data and Intelligence for Smart Systems*
- Electrical, Electronic and Control engineering
  - *Automated System Engineering*
  - *Electrical engineering*
  - *Electronics and embedded systems*
- Healthcare Engineering
  - *Medical Imaging, Signals and Systems (MISS)*
  - *Health product Design and Optimization (COPS)*
- Industrial engineering
  - *Advanced methods in industrial engineering for the industry of the future (MAGIF);*
  - *Data and artificial intelligence in industrial engineering (DIAGI).*
- Mechanics
  - *Fluid Mechanics and Energetics (MFE)*
  - *Biomechanics (BM)*
  - *System and Structure Dynamics (D2S)*
  - *Numerical Solid Mechanics (MNS)*
  - *Surfaces, Interfaces and Structures Engineering (ISIS).*
- Environmental Risk
  - *Environmental risk management*

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