

## Optimization Master program - validation rules

To obtain the master degree every student needs to obtain 30 ECTS (credits) per semester, following an examination plan which has been approved by the board of the master program. Credits are obtained for every examination with a mark of 10/20 or more, or by compensation : if during a same term the average mark (weighting each examination with the corresponding number of ECTS) is 10 or more, and no mark entering in this computation is strictly smaller than 7, then the whole semester is obtained by compensation. There is no compensation between semesters, neither in what concerns marks (an average of 11 in one semester and 9 in the other is not enough) not in what concerns ECTS (34 ECTS in one semester and 26 in the other are not ok).

During the first semester we propose 10 main courses, which are the core of our master program. Each of them is worth 5 ECTS and lasts approximately 30h. We also propose a short list of courses from other master programs of Paris-Saclay (MPRO, FIIL, AMS) and their value in ECTS is roughly proportional to their duration in hours. Pay attention that our core courses are all guaranteed to be fully schedule-compatible and to be in English (if at least one student requires it), while this is not necessarily the case for the other courses. It is also exceptionally possible to choose courses from other Master programs, other universities or schools (i.e. courses not appearing in our webpage), but only with the autorisation of the Master board (which is typically given for no more than one exterior course per term). In this case the value of the course in ECTS will be decided depending on its duration and relevance for our program. A limited number of smaller activities are credited 2 ECTS (seminars, French courses, invited courses).

During the second semester we propose some core courses at 4 ECTS, an invited course (2 ECTS), and the possibility to validate seminars or French courses (2 ECTS each), or exterior courses if explicitly agreed (ECTS depending on duration and relevance). Students must collect 10 ECTS in this way, and the remaining 20 ECTS are obtained through a research internship.

You can follow, and validate, more than 30 ECTS per term. In this case we will call *active* the exams entering the average, and *optional* the others. For the first term, the best possible minimal (i.e. no strict subset of it have the same property) combination guaranteeing at least 30 ECTS will be kept into account for the average (note that we cannot reduce the ECTS value of an exam : if you follow 6 courses at 5 ECTS + 1 courses at 3 ECTS, the latter will necessarily be optional). For the second term, the best possible minimal exam combination guaranteeing 10 ECTS will be kept, and weighted 10 in the average with the internship mark. No compensation between internship and exams is admitted.

Note that the ECTS of the seminars and of the French courses can be used for the first or second term, indifferently but cannot be used on the same term. French courses are limited to students whose mother tongue is not French and who have not been carrying studies in French for more than 2 years before this one. Exceptionally, students can ask to attend English courses (or other languages), but need the approval of the Director of the master. Consider that most language courses require compulsory frequency to the classes.

Students shall declare, by email first (and then via specific applications prepared by the administration) the list of the courses that they choose. This list must be approved by the board of the master program. It can include a number of courses and

activities ranging from 30 to 38 ECTS per term. Any modification of this list must be motivated and approved by the director of the program. No a posteriori modification (i.e. after the examination) will be accepted.

For every course there are two rounds of examinations, the second some weeks after the first. The second round could have a different structure than the first (written or oral examination, computer session, personal project...) but is guaranteed to be of the same exigence level. Independently of the way each mark is composed, there will be only one mark that is officially communicated to the secretary (who will have no access to possible partial marks on computer session, homeworks,...). Attention : for every course a student is enrolled to, the board of the master program and the teachers can decide to give a mark, less or equal than 5 and only based on assiduity, whenever the student has no mark (neither first nor second round) in such an examination and he lacks marks in the semester (he is “défaillant”, i.e. he has no marks, or not enough, considering the total of the two rounds). All students who go to a number of examinations which corresponds to at least 30 ECTS (independently of the result of the exams) are not concerned by this rule, which only applies to those students whose transcripts are not “complete”.

All marks below 7 prevent from validating the corresponding term; each term is validated if the average is at least 10 and no active examination got a mark below 7. If the average is at least 10 then all the active examinations are validated, even if their mark is below 10 (this is called validation by compensation). Students can refuse the compensation (this applies to marks between 7 and 10, hence), and also refuse a mark (even if larger than 10) if they prefer to retake the same exam. In order to do so, a signed letter should be sent to the director stating this intention no later than 7 days after being informed of the last mark of the first round of examinations. Any student who does not validate a term in the first round (because of the marks he got, or since he refused the compensation) will lose all the marks below 10 and pass to the second round. Warning : if a student voluntarily wants to pass to the second session in order to increase his own marks, he needs to refuse compensation and/or ask to transform some exam from “active” to “optional”, otherwise the first round is validated and no other active exam is possible. Making a course optional means that it does not count for the average but the mark is not lost. This can be done at any moment but is irreversible. Once a term is validated at the first round every other course validated in the second will automatically considered optional.

Transcripts are available (and can be requested to the secretary), and, at the end of the year, are made of two separate lists of active and optional courses (before the end of the year, the distinction between active and optional is not yet fixed). Hence, if you are asked to provide a transcript, you can choose whether to show or not the optional courses. Yet, tailored transcripts with partial lists of optional courses are not possible.

## ECTS Values

Core courses : 5 ECTS each

- Advanced Continuous Optimization I ;
- Optimal Control of ODEs ;
- Introduction to Operational Research and Combinatorics ;
- Dynamical Programming ;
- Game Theory ;
- Advanced Continuous Optimization II (choosing ACO I is necessary in order to choose ACO II ; this course requires compulsory presence in class) ;
- Calculus of Variations ;
- Derivative-Free Optimization ;
- Stochastic Optimization ;
- Dynamic games.

Partner courses :

- Complexity Theory (3 ECTS) ;
- Optimization in Graphs (5 ECTS) ;
- Mathematical Programming (5 ECTS) ;
- Elliptic Equations (5 ECTS).

Core courses of the second term (specialized) : 4 ECTS each

- Optimal Transport ;
- Geometric Control ;
- Tropical Algebra in Games and Optimization ;
- Control of PDEs ;
- Foundations of distributed and large-scale computing optimization ;
- Advanced Game Theory.

Specialized courses from other master programs (also 4 ECTS)

- Optimization and Statistics ;
- Learning and Sequential Optimization.

Shorter courses : 2 ECTS each

- Invited course : S. Bubeck (Bandit Convex Optimization) ;
- French or language courses ;
- Seminars.

Validation of “Seminars” : choose some seminars from the approved lists on the websites (or propose other seminars to the board of the program : most likely it will approve them) ; go and listen to the seminar ; ask the organizers to communicate your presence to the director of the master program ; choose one of the paper/subjects which has been presented in one seminar and make a short summary (3 pages approx) of the main issues of the topics and give it to the director of the program. The mark is obtained in the following way : let  $P$  be defined as a score where one obtains 1.5 points for every attended seminar and 2.5 points if there are two seminars in a row in the same day, and let  $S$  be the mark (between 0 and 20) that we give to the summary ; the final mark is obtained as  $\min\{15, P\} * (12 + S)/24$ .

**Language of the courses** : all core courses are guaranteed to be in English if required by at least one student ; as for partner courses, the MPRO courses are usually in French, and most of the other courses can often be in English if required.

## **MPRO courses**

We propose three courses from MPRO. Most of the courses of MPRO take place at CNAM (downtown Paris); the rooms are fixed week by week, and it is necessary to enroll to a mailing list in order to receive news about the rooms. Please write to [mpro@cnam.fr](mailto:mpro@cnam.fr) if you are interested. The course on Complexity has two different versions : one at ENSTA in the second part of the first term, one at CNAM in the the first part. You can choose the one you prefer (but not both).

## **Dates (semesters and internships) :**

The first term officially ends on January 26, but consider that some courses can slightly overlap with the second term. The second starts on January 29 and most specialized courses will be concentrated in the period February-March, so that you can start an internship on April 1st (which is the best for a company-based full-time internship of 5 or 6 months; academic internship can often be done in parallel to the last courses and examinations). Yet, it is your responsibility to choose courses and internships which are compatible. Also consider that second-round examinations can fall some weeks after the end of the courses, and require you to find time during your internship.

The end of the program (with the final Jury which attributes the degrees) will be around mid-September, and the “attestations de réussite” will be available around September 20. The defenses are typically organized in the first half of September (but advanced defenses for people going abroad, for instance, are possible in July). Beware that an internship which starts on April 1st and lasts 6 months will finish at the end of September : this is not a problem, but the defense will be scheduled anyway according to the above calendar, before the end of the internship. The written report can be of course a partial one.

We will organize later on a meeting to discuss about internships.

## **Recommendations :**

The program requires a non-negligible investment in terms of time and effort : be sure to devote to enough time to it from the very beginning.

Except particular courses (language courses, and courses with a lot of computer session, such as ACO II), presence in class is not compulsory, but it is indeed very important : consider that many courses are very much specialized and specific texts to prepare them simply do not exist.

Invited courses and seminars are essentially based on the assiduity, and the validation is very light : it's a way we offer for giving you “easy” ECTS; try to simplify your life attending them, so that you can easily collect ECTS. Even if you like three specialized courses, there is no point in choosing a priori to validate 4+4+4 ECTS in the second term, do rather 4+4+2+an extra 4, and we will keep the best marks. Also consider following 7 core courses in the first term (in particular, there is no point in choosing 4 courses in one block and 2 in the other : do 4+3). This allows to eliminate the worst mark.

Do not hesitate to contact the director of the program (or other professors from the Master program) for discussion, when choosing your examinations or your plans for the future.