Objectives

One of today’s major challenges is to integrate the different disciplines involved in the design, operation and maintenance of complex systems. Examples are transportation systems (cars, trains, airplanes...), energy production plants (renewable energy, thermal and nuclear power...), transportation and distribution networks (energy transmission and distribution, water distribution, gas transportation, road and railway networks) etc. Company executives, project managers, operation and design engineers need to grasp the opportunities coming from these complex, integrated systems while avoiding risks, to the extent possible. Decisions must be taken in uncertain environments: then, uncertainty needs to be handled, for effective and rational decision-making.

The course aims at providing an advanced training on concepts, methods and tools for assessing and managing risks and opportunities in complex systems. The course covers concepts and methods for the evaluation, management and control of technical risks, as well as the uncertainties in the evaluations for confident decision-support. The presented approaches are notably based on Systems Analysis, Systems Engineering, Applied Mathematics and Computer Science.

The objective is to provide the adequate tools for tackling the problem with scientific rigor.

The acquired concepts, methods and tools constitute an essential part of the skills that researchers, engineers and managers must have.

In the end, the course provides the knowledge and competence need to architect and operate complex systems, i.e. to make them efficient and reliable in operation, and resilient to major hazardous events.

One key objective of the course is to engage multi-disciplinary and multi-cultural teams of students in the definition, design and development of a scientific research process in the areas of interest for the disciplines of risk assessment and uncertainty analysis. To this aim, “mixed” teams of participants with different backgrounds and Institutions of origin will be formed at the beginning of the course, and charged with the definition and statement of a research problem to be addressed. The procedures and frames of work for the development of original solutions to the problems defined by the various teams will be discussed in self-managed sessions at the end of each day. At the end of the open seminar of the last day of the course, the various teams will have to present the definitions of the problems and illustrate the research work that they intend to carry out for their original solutions. The teams will then have to continue the work throughout the following semester, with the objective of producing scientific papers presenting the findings of the research. Once positively evaluated by the Professors of the
School, these papers will be submitted to the appropriate international communities of peers for publication. Engagement by industrial partners in the monitoring of the projects will be sought. The benefits of the projects are expected to be an independent and direct exposure to: research problem definition and solution; multi-national, multi-cultural, multi-disciplinary, long-distance research work.

Programme of teaching and key concepts

Project Work
Multi-disciplinary and mixed teams (Beihang, CentraleSupélec, Politecnico di Milano, KTH, UPM) are going to be formed and given the task of defining, planning and conducting a research project on the topics of the Course, with the engagement of industrial partners. The project will be carried out over a period of six months. Eventually the original developments and results will be summarized in a scientific paper, which will be reviewed and, as done last year, possibly proposed for presentation to a Conference, if of adequate quality. This project is funded by the T.I.M.E. Association, an international network of 53 Higher Education Institutions. This T.I.M.E. project proposes to experiment innovative educational formats for fostering interaction between PhD candidates and industry. The main goals are in two directions: first, to give PhD candidates a concrete overview on research and innovation activities in industry and their own potential role in the future in such contexts; second, to put industry in contact with PhD candidates from different disciplines and in an international context. The PhD candidates will work in teams to identify possible solutions, guided by the industrial researchers and by tutors, and at the end will present and discuss their results. Lectures/seminars given by social scientists on the theme of interaction (both with external parties and within team members) will be also given during the course.

Programme
**Monday Morning:** Vulnerability, Risk and Resilience of Complex Systems and Critical Infrastructures (4h)
**Prof. Enrico Zio (CentraleSupélec/Polimi)**

**Monday Afternoon:** Tutorials (3h)
**Dr. Yanfu Li (CentraleSupélec)**

**Monday Welcome Industry Cocktail**
Presentation of the team projects of the 2nd edition and definition of the project teams.

**Tuesday Morning:** Advanced statistics (4h)
**Prof. Piercesare Secchi (Polimi)**

**Tuesday Afternoon:** Tutorials (3h) + Project Work **Dr. Simone Vantini (Polimi)**

**Wednesday Morning:** Uncertainty modeling (4h)
**Dr. Nicola Pedroni (CentraleSupélec)**

**Wednesday Afternoon:** Tutorials (3h) + Project Work **Dr. Elisa Ferrario (CentraleSupélec)**

**Wednesday Industry Cocktail**

**Thursday Morning:** (4h) High-level modeling languages for safety and reliability analyses (4h)
**Professor Antoine Rauzy (Centrale)**

**Thursday Afternoon:** (3h) Uncertainties in accelerated testing: models and testing design **Professor Xiaoyang Li (CRESCI-Beihang University)**

**Thursday Evening Industry Cocktail**
- Presentation and discussion of the team project proposals

**Friday:** Second Forum on Research: Electricité de France

**Registration**
Participation is free of charge.
The number of participants is limited to 20.
Please register by sending your CV by email to corine.olivier@centralesupelec.fr
Nicola.pedroni@centralesupelec.fr

Registration deadline: September 1st 2015.