ISN	S8	En

Systems engineering and dependability	Nicolae Brinzei
Systems dependability	Nicolae Brinzei

- ***Objectifs***

Digital systems used to control or improve the performance of industrial systems must meet reliability and/or availability requirements in order to be safe in their operation.
This teaching module introduces the fundamental concepts of dependability and shows to engineers that even if a system failure can't be avoided always, it is possible to determine the failure causes and to assess their impact on system performances. The teaching module presents the modeling and the analysis of the dependability of systems using different formalisms by underlining their complementarity.

- ***Compétences acquises***

Upon completion of this teaching module, students will be able to:
- analyze a system from a dysfunctional point of view
- asses the reliability of system components
- model the systems in order to asses their dependability in a probabilistic way

- ***Prérequis***

- teaching module on "Probability and statistics"(S6)
- teaching module on "Modeling of Discrete Event Systems" (S7)

- ***Programme pédagogique CM : 20 TD : 2 TP : 18***

Lectures:
- Bases and definitions: reliability, availability, maintenability, safety (RAMS), MTTF, MTBF, MTTR
- Reliability of system components
- Qualitative approaches for risk analysis: PRA, FMEA, HAZOP
- Combinatorial approaches for modeling and assessment of systems dependability:
  - Reliability Block Diagrams (RBD)
  - Fault Trees (FT)
- States-transitions approaches for modeling and assessment of systems dependability:
  - analytical approaches: Markov chains (MC), stochastic Petri nets (SPN)
  - simulation approach: Stochastic Activity Networks (SAN)
- Functional safety: study and analysis of Safety Instrumented Systems (SIS) in accordance with current norms and standards (IEC 61508); safety integrity levels (SIL)

Tutorial:
- systems modeling by SAN

Practical work (2TP*3h):
- modeling and probabilistic assessment of binary non-repairable systems by RBD and FT (with GRIF software)
- modeling and probabilistic assessment of multi-state repairable/reconfigurable systems par MC and SPN (with GRIF software)
- modeling and assessment of SIS and their SIL (with GRIF software)

- ***Evaluation***

- exam to evaluate the level of theoretical knowledge of the approaches of modeling and evaluation of the systems dependability, to evaluate the use of these approaches
- continuous evaluation during tutorial and practical work sessions to evaluate the ability to model, evaluate and analyze the dependability of critical industrial systems