# ASTE 599: Reliability of Space Systems

**Course Description:**
This course provides engineering and science students with the tools and techniques necessary for reliable system design and operations. The students will be encouraged to think of the concepts of reliability and risk as measures of performance of a system and within the context of the system design, development and operational lifecycle. The course will cover 1) the basic concepts and analytical methods of Systems Reliability Theory 2) Probabilistic Risk Assessment and its application to space systems and payloads and 3) The failure behaviors of modern flight computer based systems. The course textbook will be supplemented with papers that describe the application of risk and reliability engineering to space systems.

The course project (individual) will provide students with an opportunity to study and formulate an example reliability and risk assessment problem of their choice and each student will be required to prepare an initial problem formulation/proposal for their project after the midterm and then a short final report.

**Course Prerequisite:** Graduate standing in engineering or science

**Course Goals:** The main goal of this class is to give the students an in-depth understanding of reliability engineering as a means to manage uncertainty during the lifecycle of a space system design and operations. It will equip them with the analytical tools to recognize, formulate, reason and solve complex reliability and risk analysis problems. Throughout the class, we will emphasize the value of looking at the lifecycle of the design, development and operation of an engineering system and understanding how to best utilize the analytical tools in solving real world problems.

**Textbooks:**
Book: "System Reliability Theory: Models and Statistical Methods" by Arnljot Hoyland and Marvin Rausand.

**Other Material:**
"Probabilistic Risk Assessment Procedures Guide for NASA Managers and Practitioners"
By: M. Stamatalatos, et. al, Available on-line:
Selected papers and reading material will be provided to students during the class.

**Class Sessions:**
Students will be assigned reading assignments which they are expected to read before Class. Homework assignments are weekly.

## Course Requirements and Grading:

| Requirement | Total Points |
|---|---|
| Homework | 30 |
| Midterm Exam | 25 |
| Project | 20 |
| Final Exam | 25 |
| Total | 100 |

## Schedule:

| Session | Date | Class Topic | Reading Assignment | HW due |
|---|---|---|---|---|
| 1 | tbd | Introduction to Reliability & Risk Engineering | Chapter 1 | |
| 2 | tbd | Review of Probability/ Failure Models | Chapter 2, other | HW–1 |
| 3 | tbd | Failure Models | Chapter 2, other. | HW-2 |
| 4 | tbd | Fault Tree Analysis | Chapter 3, other | HW-3 |
| 5 | tbd | Fault Tree Analysis, continued | Chapter 4 | HW-4 |
| 6 | tbd | Markov Models | Chapter 6 | HW-5 |
| 7 | tbd | Component Importance and Sensitivity Analysis | Chapter 5 | |
| 8 | tbd | Midterm | | |
| 9 | tbd | Probabilistic Risk Assessment | PRA reference document | Project Proposals due |
| 10 | tbd | Probabilistic Risk Assessment | PRA reference document | HW-6 |
| 11 | tbd | Reliability Engineering for Computer Systems | lecture notes | HW-7 |
| 12 | tbd | Bayesian Belief Networks | Chapter 11 | HW-8 |
| 13 | tbd | Bayesian Belief Networks/ Review of Statistics | Lecture notes | HW-9 |
| 14 | tbd | Data Analysis for Reliability Engineering | Chapter 12 | Project reports due |
| 15 | tbd | Review | | HW-10 |
| 16 | tbd | Final Exam | | |

## Statement on Academic Conduct and Support Systems

### Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

### Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* *http://emergency.usc.edu* will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.