

M057	MR,IPM- elective-Year 2	Reliability Theory	L+P+S 2+1+1	ECTS 6
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Course objectives. In a formal mathematical way, but with an emphasis on application, the fundamentals of reliability theory will be presented.

Course prerequisites. *Basic statistics*, Differential Calculus and Integral Calculus.

Syllabus.

1. Introduction. A short historical account. Areas of application.
2. Basic concepts of reliability theory. Reliability function. Failure distribution. Instantaneous failure rate (hazard function). Mean time between failures.
3. Some distributions in reliability theory. Continuous distributions: exponential, normal, log-normal, Weibull, gamma and beta distributions. Discrete distributions: binomial, Poisson, geometric and hypergeometric distributions.
4. Estimating the distribution on the basis of empirical data. Graphical methods: histograms and probability plot. Analytical methods: method of moments, maximum likelihood estimation and least squares method.
5. Maintenance strategy of renewable systems. Renewal theory. Renewal function and density. Replacement based on age. Periodic replacement. Random replacement.
6. Optimum maintenance policies. Replacement policies. Inspection policies.
7. Redundant system. Systems with cold-standby redundancy. Systems with hot-standby redundancy.

Expected learning outcomes.

After completing the course, students are expected to be able to:

- specify the area of application;
- demonstrate the definitions of basic concepts;
- state the basic distributions in the theory of reliability and indicate their basic properties;
- identify and apply different methods to estimate the distribution on the basis of empirical data;
- describe strategies of replacement for renewal of the system;
- explain the differences between the systems with hot and cold standby redundancy.

Teaching methods and student assessment. Lectures are obligatory. Lectures present basic concepts, mathematical aspects and problems of reliability theory. The second part of the course is used for presentations of students' essays. Attendance at seminars is obligatory. The exam consists of a written and an oral part and it is taken after completion of lectures. During the semester, students can write an essay. Students may influence their final grade by preparing an essay that can replace the oral examination.

Can the course be taught in English: Yes.

Basic literature:

1. R. Barlow, F. Proschan, *Mathematical Theory of Reliability*, SIAM, Philadelphia, 1996.

Recommended literature :

1. S. V. Vukadinović, D. B. Teodorović, *Elementi teorije pouzdanosti i teorije obnavljanja tehničkih sustava*, Privredni pregled, Beograd, 1979.
2. D. T. P. O'Connor, *Practical Reliability Engineering*, Heyden & Son, London, 1995.
3. R.E. Barlow, *Engineering Reliability*, SIAM, Philadelphia, 1998.
4. A. Birolini, *Reliability Engineering. Theory and Practice*, Springer Verlag, Berlin, 2007.
5. B. Dodson, D. Nolan, *Reliability Engineering Handbook*, CRC Press, Boca Raton, 1999.
6. J.F. Lawless, *Statistical Models and Methods for Lifetime Data*, Wiley, New York, 1982.
7. W. Nelson, *Applied life data analysis*, Wiley, New York, 1982.

8. B. W. Silverman, Density estimation for Statistics and Data Analysis, Chapman & Hall/CRC, Boca Raton, 2000.
9. P. A. Tobias, D. C. Trindade, Applied Reliability, Chapman & Hall/CRC, Boca Raton, 1995.
- E. Zio, An Introduction to the Basics of Reliability and Risk Analysis, World Scientific, New Jersey, 2007.