## DOCTORAL SCHOOL OF WROCŁAW UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE: Wojciech Puła DEPARTMENT: Civil Engineering Department SCIENTIFIC DISCIPLINE: Civil Engineering and Transport

## **COURSE CARD**

Course name in Polish: Metody probabilistyczne w inżynierii Course name in English: Probabilistic methods in engineering Course language: <u>English</u> University-wide general course type\*: The course is intended for all PhD students: YES / NO <del>1) BASIC COURSE</del> 2) SPECIALIST COURSE <del>3) SEMINAR</del> 4) HUMANISTIC COURSE 5) LANGUAGE

**Subject code:** ILQ100024W

\* delete as applicable

|  | Lecture | Foreign<br>language<br>course | Seminar | Mixed forms |
|--|---------|-------------------------------|---------|-------------|
| Number of hours of organized classes in university (ZZU) | 30      | -                             | -       | -           |
| Grading  | Exam    | -                             | -       | -           |
| Number of ECTS points                                    | 0       | -                             | -       | -           |

## PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A basic course in soil mechanics and foundation engineering

- 2. A basic course in probability and statistics
- 3. A course in calculus

## **COURSE OBJECTIVES**

C1. To enable PhD students to use probabilistic methods within their PhD theses. C2. To demonstrate students the rules of probability based design

## **PROGRAM CONTENTS**

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|       | Number of hours  |    |
|-------|--|----|
| Lec1  | General comments on uncertainty in geotechnical analyses.<br>Sources and types of uncertainty in geomechanical properties.   | 1  |
| Lec2  | Basic discrete probability theory.   | 1  |
| Lec3  | Some basic concepts of probability measures theory.  | 2  |
| Lec4  | Random variables and probability distributions, expected values,<br>variance, moments of higher order. Random vectors, stochastic<br>independence, covariance/correlation<br>Common discrete and continuous distributions. | 2  |
| Lec5  | Convergence of probability distributions.<br>Limit theorems  | 1  |
| Lec6  | Stochastic processes and random fields   | 4  |
| Lec7  | Probabilistic modelling of soil properties. Estimation problems.<br>Theory and examples  | 2  |
| Lec8  | Structural reliability methods and reliability assessments in geomechanics   | 3  |
| Lec9  | Reliability oriented simulation techniques. Random fields Simulation.  | 2  |
| Lec9  | Advanced reliability evaluations. Bearing capacity of shallow foundations.   | 2  |
| Lec9  | Advanced reliability evaluation. Response surface method and its application to foundation settlement problem  | 2  |
| Lec10 | Stochastic finite element method and the random element method (RFEM). An overview.  | 2  |
| Lec11 | Applications of RFEM to various geomechanical problems.  | 2  |
| Lec12 | Reliability based design. General rules and examples.  | 1  |
| Lec13 | Calibration of characteristic and design values in conjunction of rules given by Eurocodes   | 3  |
|       | Total hours:   | 30 |

## TEACHING TOOLS USED

- N1. Classical lecture
- N2. Multimedial presentations
- N3. Discussions of problems.

| ACHIEVED SUBJECT LEARNING OUTCOMES |                          |   |  |  |
|------------------------------------|--------------------------|---|--|--|
| Type of learning outcome           | Code of learning outcome | Assessment of learning outcome  |  |  |
| Knowledge                          | P8S_WG                   | has knowledge at an advanced level of a basic nature for<br>a field related to the area of scientific research,<br>including the latest methods of research and verification<br>of achieved results |  |  |
| Knowledge                          | P8S_W                    | Understanding the basic methods of structural reliability methods.  |  |  |
| Knowledge                          | P8S_WK                   | A knowledge in reliability based design   |  |  |

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| Skills            | P8U_U  | An elementary skill in probabilistic modelling  |
|-------------------|--------|---|
| Skills            | P8S_UK | An elementary skill in reliability evaluations  |
| Skills            | P8S_UO | A skill in characteristic and design evaluation |
| Social competence |        |   |

## PRIMARY AND SECONDARY LITERATURE

## **PRIMARY LITERATURE:**

- [1] FENTON G.A., GRIFFITHS D.V. (2008), *Risk assessment in geotechnical engineering*. John Wiley & Sons, Hoboken, N.J.
- [2] EUROCODE 7 AND RELIABILITY-BASED DESIGN. IN: RELIABILITY BASED DESIGN IN GEOTECHNICAL ENGINEERING, TAYLOR AND FRANCIS, LONDON–NEW YORK,
- [3] BAECHER G.B., CHRISTIAN J.T. (2003), RELIABILITY AND STATISTICS IN GEOTECHNICAL
- [4] ENGINEERING. J. WILEY & SONS, CHICHESTER.
- [5] FISZ M. (1980), PROBABILITY THEORY AND MATHEMATICAL statistics. Krieger Publ. Co.

## **SECONDARY LITERATURE:**

- [1] DITLEVSEN O., MADSEN H.O. (1996), STRUCTURAL RELIABILITY METHODS. JOHN WILEY & SONS, CHICHESTER.
- [2] PROBABILISTIC METHODS IN GEOTECHNICAL ENGINEERING. ED. BY D. V. GRIFFITHS,
- [3] GORDON A. FENTON. WIEN; NEW YORK: SPRINGER, COP. 2007. S. 127-145. ISBN: 978-3-211-73365-3.
- [4] MELCHERS R.E. (2018), STRUCTURAL RELIABILITY. ANALYSIS AND PREDICTION. 3RD EDITION, JOHN WILEY & SONS.

#### SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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