Faculty of Fundamental Problems of Technology
COURSE CARD

| | | |
|---|---|---|
| Name in polish | : | **Zaawansowane Zagadnienia Kombinatoryki** |
| Name in english | : | **Advanced Topics of Combinatorics** |
| Field of study | : | Computer Science |
| Specialty (if applicable) | : | |
| Undergraduate degree and form of | : | masters, stationary |
| Type of course | : | optional |
| Course code | : | E2_W30 |
| Group rate | : | Yes |

| | Lectures | Exercides | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of classes held in schools (ZZU) | 30 | 30 | | | |
| The total number of hours of student workload (CNPS) | 90 | 90 | | | |
| Assesment | pass | | | | |
| For a group of courses final course mark | X | | | | |
| Number of ECTS credits | 3 | 3 | | | |
| including the number of points corresponding to the classes of practical (P) | | 3 | | | |
| including the number of points corresponding occupations requiring direct contact (BK) | 3 | 3 | | | |

PREREQUISITES FOR KNOWLEDGE, SKILLS AND OTHER POWERS

The knowledge of basic topics of Mathematical analysis 1, Discrete Mathematics and Probabilistic methods and statistics (Probability theory) is required. The elementary knowledge on Graph theory is recommended but not mandatory.

COURSE OBJECTIVES

**C1** Presentation of selected advanced issues of modern combinatorics.

**C2** Learning modern techniques used to solve combinatorial problems.

## COURSE LEARNING OUTCOMES

The scope of the student's knowledge:

**W1** Student understands the concept of issues in extremal combinatorics and is able to indicate their examples.

**W2** Student knows the basics of Ramsey theory.

**W3** Student knows the elementary issues of percolation and understands their threshold nature.

The student skills:

**U1** Student can apply basic probability tools in analyzing a combinatorial problem

**U2** Student can use the theorems of Ramsey theory to identify features of mathematical objects.

**U3** Student can indicate threshold character of different percolation processes.

The student's social competence:

**K1** Student can introduce the concept and analysis of solutions (for combinatorial problems) using probability tools.

## COURSE CONTENT

### Type of classes - lectures

| | | |
|---|---|---|
| Wy1 | Probability theory - revision. | 2h |
| Wy2 | Graph theory - basics | 2h |
| Wy3 | Extremal combinatorics | 4h |
| Wy4 | Random graphs | 2h |
| Wy5 | Evolution of a random graph G(n,p) | 2h |
| Wy6 | Ramsey theory, part 1 | 2h |
| Wy7 | Ramsey theory, part 2 | 2h |
| Wy8 | Ramsey theory, part 3 | 2h |
| Wy9 | Percolation | 2h |
| Wy10 | The critical phenomenon | 2h |
| Wy11 | Bootstrap percolation | 4h |
| Wy12 | Open problems | 4h |

### Type of classes - exercises

| | | |
|---|---|---|
| Ćw1 | Probability theory, basics - revision | 2h |
| Ćw2 | Graph theory - basics | 2h |
| Ćw3 | Extremal combinatorics - examples | 4h |
| Ćw4 | Random graphs | 2h |
| Ćw5 | G(n,p) model | 2h |
| Ćw6 | Ramsey's theorem | 2h |
| Ćw7 | Ramsey numbers | 2h |
| Ćw8 | Van der Waerden's theorem | 2h |
| Ćw9 | Percolation - basics | 2h |
| Ćw10 | Threshold probability | 2h |
| Ćw11 | Bootstrap percolation | 4h |
| Ćw12 | Open problems - discussion | 4h |

| Applied learning tools |
|---|
| 1. Traditional lecture |
| 2. Solving tasks and problems |
| 3. Consultation |
| 4. Self-study students |

## EVALUATION OF THE EFFECTS OF EDUCATION ACHIEVEMENTS

| Value | Number of training effect | Way to evaluate the effect of education |
|---|---|---|
| F1 | W1-W3, K1-K1 | Test |
| F2 | U1-U3, K1-K1 | Classroom activity |
| P=90%*F1+10%*F2 | | |

## BASIC AND ADDITIONAL READING

1. Svante Janson, Tomasz Łuczak, Andrzej Ruciński, Random Graphs

2. Ronald L. Graham, Bruce L. Rothschild, Joel H. Spencer, Ramsey Theory, 2nd Edition

3. Geoffrey Grimmett, Percolation

## SUPERVISOR OF COURSE

dr inż. Małgorzata Sulkowska

RELATIONSHIP MATRIX EFFECTS OF EDUCATION FOR THE COURSE
Advanced Topics of Combinatorics
WITH EFFECTS OF EDUCATION ON THE DIRECTION OF COMPUTER SCIENCE

| Course training effect | Reference to the effect of the learning outcomes defined for the field of study and specialization (if applicable) | Objectives of the course** | The contents of the course** | Number of teaching tools** |
|---|---|---|---|---|
| W1 | K2_W01 K2_W05 | C1 | Wy1-Wy12 | 1 3 4 |
| W2 | K2_W01 | C1 | Wy1-Wy12 | 1 3 4 |
| W3 | K2_W01 K2_W02 | C1 | Wy1-Wy12 | 1 3 4 |
| U1 | K2_U12_A | C2 | Ćw1-Ćw12 | 2 3 4 |
| U2 | K2_U09_A | C2 | Ćw1-Ćw12 | 2 3 4 |
| U3 | K2_U09_A | C2 | Ćw1-Ćw12 | 2 3 4 |
| K1 | K2_K13 K2_K17 | C1 C2 | Wy1-Wy12 Ćw1-Ćw12 | 1 2 3 4 |