## STUDY MODULE DESCRIPTION FORM

| Name of the module/subject **Advanced Data Compression** | | Code **1010802131010842912** |
|---|---|---|

| Field of study **Electronics and Telecommunications** | Profile of study (general academic, practical) **general academic** | Year /Semester **2 / 3** |
|---|---|---|

| Elective path/specialty **Information and Communication** | Subject offered in: **English** | Course (compulsory, elective) **elective** |
|---|---|---|

| Cycle of study: **Second-cycle studies** | Form of study (full-time, part-time) **full-time** |
|---|---|

| No. of hours | | | | | No. of credits **3** |
|---|---|---|---|---|---|
| Lecture: **2** | Classes: **-** | Laboratory: **-** | Project/seminars: **1** | | |

| Status of the course in the study program (Basic, major, other) **major** | (university-wide, from another field) **from field** |
|---|---|

| Education areas and fields of science and art **technical sciences** Technical sciences | ECTS distribution (number and %**)** **3  100%** **3   100%** |
|---|---|

### Responsible for subject / lecturer:

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### Prerequisites in terms of knowledge, skills and social competencies:

| 1 | **Knowledge** | 1. Has a systematic knowledge of mathematical analysis, algebra and theory of probability (K1_W01) |
|---|---|---|
| | | 2. Has a systematic knowledge, together with necessary mathematical background, of 1D signal theory; this knowledge allows him/her to understand the representation of signals and signal analysis in time domain and frequency domain (K1_W06) |
| | | 3. Knows the principles of construction of computer programs ; has knowledge from the area of computing science; knows the syntax of C, C++, C#, MatLab (K1_W09) |
| 2 | **Skills** | 1. Is able to extract information from Polish or English language literature, databases and other sources. Is able to synthesize gathered information, draw conclusions, and justify opinions (K1_U01) |
| | | 2. Demonstrates the ability to solve problems related to signal analysis in time domain and frequency (K1_U10) |
| | | 3. Is able to write software for basic computational algorithms, using popular programming languages (e.g. Matlab, C) (K1_U13) |
| 3 | **Social competencies** | 1. Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study (K1_K01) |

### Assumptions and objectives of the course:

Familiarize students with advanced compression techniques for general data, audio data, image data, and hyperspectral data. There are presented methods of effective representation of text data using Burrows-Wheeler transform, and also methods using sophisticated algorithms of data statistics modeling. There are presented contemporary tools of audio compression. Additionally, the goal is to familiarize students with advanced techniques of hybrid video compression as well as subband compression techniques, the idea of distributed video coding, methods of context-adaptive entropy coding, and compression techniques of hyperspectral data.

### Study outcomes and reference to the educational results for a field of study

### Knowledge:

1. . The student has skills associated with the state of the art compression techniques of text data, audio data, image and video data, and hyperspectral data - [K2_W05]

2. The student has knowledge in terms of idea of the known data compression algorithms, and is able to use the known methods for effective representation and transmission of data in telecommunication channel - [K2_W06]

3. The student knows advantages and disadvantages of the known compression techniques, and understand well the benefits from using the methods for effective representation of data - [K2_W09]

### Skills:

1. The student is able to give the mathematical description of the known algorithms of data compression and to propose appropriate method in order to efficiently represent data of any type  - [K2_U03]

2. The student is able to perform compression of a given type data in order to represent them in an efficient way, and is able to do the analysis of compression performance of the method  - [K2_U03]

3. On the basis of the known methods, the student is able to design the own compression method dedicated to a defined application  - [K2_U03]

**Social competencies:**

1. The student understands the need for continuous training in order to improve skills  - [K2_K04]

## Assessment  methods of study outcomes

Written and/or oral exam from material presented during lectures.

Reports from thematically homogenous laboratory exercises and/or an exams.

## Course description

Lectures:

Advanced techniques of general data compression (methods that use the Burrow-Wheeler transform and advanced data statistics modeling techniques).

Advanced compression of audio data (selected contemporary methods).

Advanced image and video data compression (hybrid coding schemes, sub-band coding).

Distributed video coding.

Advanced context-based adaptive entropy coding techniques (review of the selected contemporary methods).

Advanced compression of hyperspectral data.

Laboratories:

Advanced techniques of general data compression (measuring the compression performance of the selected methods).

Analysis of compression performance of the selected coding tools used in audio compression.

Analysis of the selected methods of image and video compression.

Compression performance of the selected contemporary entropy coding techniques.

Compression of hyperspectral data.

Implementation of the own data compressor (not obligatory).

### Basic bibliography:

1. M. Domański, Obraz cyfrowy, WKŁ, 2010

2. K. Sayood, Kompresja danych ? wprowadzenie, Wydawnictwo RM, 2002

### Additional bibliography:

1. G. Salomon, G. Motta, Handbook of data compression, Springer-Verlag, 2010

2. J. W. Woods, Multidimensional Signal, Image, and Video Processing and Coding, Elsevier, 2012.

3. P. L. Dragotti, M. Gastpar, Distributed Source Coding, Elsevier, 2009.

4. G. Motta, F. Rizzo, J. A. Storer (editors), Hyperspectral Data Compression, Springer, 2010

5. Technical documentation of working groups MPEG, VCEG and other related.

## Result of average student's workload

| Activity | Time (working hours) |
|---|---|
| 1. Lectures (30 hours) + laboratories (15 hours) | 45 |
| 2. Preparation for laboratories | 10 |
| 3. The study of the literature | 10 |
| 4. Preparation for the exam | 10 |
| 5. Participation in the exam | 3 |
| 6. Consulting with teachers | 2 |

## Student's workload

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 80 | 3 |

| | | |
|---|---|---|
| Contact hours | 50 | 2 |
| Practical activities | 25 | 1 |