| Structure of measuring equipment         1010402211010421145           Field of study         Profile of study<br>(general academic, practical)<br>general academic         Year /Semester           TECHNICAL PHYSICS         general academic         1/1           Elective pathispacially         -         Subject of trend in:<br>Polish         Course (computery, elective)<br>obligatory           Cycle of study:         -         Form of study (ull-time.part-time)         Course (computery, elective)<br>obligatory           Cycle of study:         -         Ecctors:         full-time           No. of nours         -         Project/seminars:         1           Lecture:         2         Classes:         -         Laboratory:         -           Strutus of the course in the study program (Basic, major, other)         university-wide         ECTS distribution (number<br>and %)           Education areas and fields of science and at         ECTS distribution (number<br>and %)         2         100%           technical sciences         2         100%         2         100%           Technical sciences         2         100%         2         100%           Prorequisites in terms of knowledge, skills and social competencies:         1         1         Knowledge of physics, mathematics, electronics, mechanics, oplics and vacuum technology at<br>the Technical Physics undergraduata  | STUDY MODULE DESCRIPTION FORM  |  |                                |  |                           |  |  |  |
|--|--|--|--------------------------------|--|---------------------------|--|--|--|
| TECHNICAL PHYSICS         Image and a cademic, practical)         1/1           Subject offered in:<br>Polish         Course (computery, elective)<br>obligatory         Course (computery, elective)<br>obligatory           Cycle of study:         From of study (full-lime, part-time)         Form of study (full-lime, part-time)         Course (computery, elective)<br>obligatory           No. of hours         Lecture:         2         Classes: - Laboratory: - Project/seminars: 1         No. of oreitis           Status of the course in the study program (Basic, major, other)         (university-wide, from another field)         0           Education areas and fields of science and art         ECT adiation (number<br>and %)         2         100%         2   | Name of the module/subject<br>Structure of measuring equipment   |  |                                |  |                           |  |  |  |
| -         Polish         obligatory           Cycle of study:         Form of study (full-time_part-time)         Form of study (full-time_part-time)           Second-cycle studies         full-time         No. of credits           No. of hours         2         Classes: - Laboratory: - Project/seminars: 1         2           Status of the course in the study program (Basic, major, other)         (university-wide, from another field)         2           Education areas and fields of science and ant         ECTS distribution (number and %)         2         100%           technical sciences         2         100%         2         100%           Technical sciences         2         100%         2         100%           Responsible for subject / lecturer:         dr Andrzej Jarosz         2         100%         2         100%           I. eli 61 66352266         Faculty of Technical Physics         U. Potrows 0, 80-965 Poznah         2         10%           Prerequisites in terms of knowledge, skills and social competencies:         1         Knowledge of physics, mathematics, electronics, mechanics, optics and vacuum technology at the Technical Physics undergraduate course level. Basic knowledge of angineering graphics.           2         Skills         Skill in physical problem solving, skill in acquiring information from listed sources, ability to make engineering drawing. Skill in using of CAD pr   | Field of study TECHNICAL PHYSICS   |  |                                | (general academic, practical<br>general academic | ) 1/1                     |  |  |  |
| Second-cycle studies         full-time           No. of hours         No. of credits           Lecture:         2         Classes:         -         Laboratory:         -         Project/seminars:         1         2           Status of the course in the study program (Basic, major, other)         (university-wide, from another field)         university-wide           Education areas and fields of science and art         ECT3 distribution (number and %)         2         100%         2  | Elective   | path/specialty   | -                              | -  |                           |  |  |  |
| No. of hours       No. of credits         Lecture:       2       Classes:       -       Laboratory:       -       Project/seminars:       1       2         Status of the course in the study program (Basic, major, other)       (university-wide, from another field)       university-wide         Education areas and fields of science and art       university-wide, from another field)       ECTS distribution (number and %)         technical sciences       2       100%       2       100%         Responsible for subject / lecturer:       dr Andrzej Jarosz       2       100%       2       100%         Responsible for subject / lecturer:       dr Andrzej Jarosz       email: andrzej Jarosz @put.poznan.pl       tei.61 6653226       2       100%         Prerequisites in terms of knowledge, skills and social competencies:       Introve 3, 60-965 Poznan       Introve 3, 60-965 Poznan         1       Knowledge       Knowledge of physics, mathematics, electronics, mechanics, optics and vacuum technology at the Technical Physical problem solving, skill in acquiring information from listed sources, ability to make engineering drawing. Skill in using of CAD programs.         3       Social       Understanding the necessity of personal competence development.         Study outcomes and reference to the educational results for a field of study systems from selected fields of physics.         3. Development of skills in knowledge  | Cycle of   | study:   |                                |  |                           |  |  |  |
| Lecture:       2       Classes:       -       Laboratory:       -       Project/seminars:       1       2         Status of the course in the study program (Basic, major, other)       (university-wide, from another field)       university-wide         Education areas and fields of science and art       ECTS distribution (number and %)       2       100%         technical sciences       2       100%       2       100%         Responsible for subject / lecturer:   | Second-cycle studies   |  |                                | full-time  |                           |  |  |  |
| Status of the course in the study program (Basic, major, other)       (university-wide, from another field)         Status of the course in the study program (Basic, major, other)       (university-wide, from another field)         Education areas and fields of science and at       ECTS distribution (number and %)         technical sciences       2         Technical sciences       2         dr Andrzej Jarosz       email: andrzej jarosz@put.poznan.pl         tel. 61 6653226       Faculty of Technical Physics         ul. Piotrowo 3, 60-965 Poznań       Ectical Physics         ul. Piotrowo 3, 60-965 Poznań       Skills         Skills       Skills         Skills       Skill in physical problem solving, skill in acquiring information from listed sources, ability to make engineering drawing. Skill in using of CAD programs.         3       Social competencies       Understanding the necessity of personal competence development.         2. Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments illustrated by exemplary systems from selected fields of physics.         2. Development of sell-reliance in knowledge acquirement.       Study outcomes and reference to the educational results for a field of study         Knowledge:       1       Study outcomes and reference to the education and operation of selected measurement systems for a selected fields of physics.         2. Dev  |  |  |                                |  |                           |  |  |  |
| other         university-wide           Education areas and fields of science and art         ECTS distribution (number<br>and %)           technical sciences         2 100%           Technical sciences         2 100%           Responsible for subject / lecturer:         2 100%           dr Andrzej Jarosz<br>email: andrzej jarosz@put.poznan.pl<br>tel. 61 6653226         Faculty of Technical Physics<br>ul. Piotrowo 3, 60-965 Poznań           Prerequisites in terms of knowledge, skills and social competencies:         Image: Science Scientific Instruments Science Science Science ScienceS   |  | 0100000  |                                |  | •                         |  |  |  |
| Education areas and fields of science and art technical sciences Technical sciences 2 100% 2 100% 2 100% Cesting a science sci | Status o   | -  |                                |  |                           |  |  |  |
| Technical sciences       2 100%         Responsible for subject / lecturer:       dr Andrzej Jarosz         dr Andrzej Jarosz       email: andrzej jarosz@put.poznan.pl         tel. 61 6653226       Faculty of Technical Physics         ul. Piotrowo 3, 60-965 Poznań       Prerequisites in terms of knowledge, skills and social competencies:         1       Knowledge       Knowledge of physics, mathematics, electronics, mechanics, optics and vacuum technology at the Technical Physics undergraduate course level. Basic knowledge of engineering graphics.         2       Skills       Skill in physical problem solving, skill in acquiring information from listed sources, ability to make engineering drawing. Skill in acquiring information from listed sources, ability to make engineering drawing. Skill in source development.         3       Social competencies       Understanding the necessity of personal competence development.         4       Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fileds of physics.         2       Development of skills in knowledge acquirement.         3       Study outcomes and reference to the educational results for a field of study         Knowledge:       1         1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W071]         2. Student, who has completed the course, is  | Educatio   | on areas and fields of sci   | ence and art                   |  | ECTS distribution (number |  |  |  |
| Responsible for subject / lecturer:         dr Andrzej Jarosz<br>email: andrzej jarosz@put.poznan.pl         tel. 61 6653226         Faculty of Technical Physics         ul. Piotrowo 3, 60-666 Poznań    Prerequisites in terms of knowledge, skills and social competencies:          1       Knowledge         2       Skills         3       Social<br>competencies         3       Social<br>competencies         4       Knowledge of physics, mathematics, electronics, mechanics, optics and vacuum technology at<br>the Technical Physics undergraduate course level. Basic knowledge of engineering graphics.         2       Skills         3       Social<br>competencies         4       Understanding the necessity of personal competence development.         6       Assumptions and objectives of the course:         1       Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary<br>systems from selected fields of physics.         2       Development of skills in knowledge of physics application to solving problems connected to construction an configuration of<br>scientific instruments systems.         3       Development of self-reliance in knowledge acquirement.         Study outcomes and reference to the educational results for a field of study         Microwice       1         1. Student, who has completed the course, is able to   | techn  | ical sciences  |                                |  | 2 100%                    |  |  |  |
| dr Andrzej Jarosz         email: andrzej Jarosz @put.poznan.pl         tel. 61 6653226         Faculty of Technical Physics         ul. Piotrowo 3, 60-965 Poznań    Prerequisites in terms of knowledge, skills and social competencies:          1       Knowledge         2       Skills         3       Social competencies         3       Social competencies         4       Understanding the necessity of personal competence development.    Assumptions and objectives of the course:          1.       Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fields of physics.          2. Development of skills in knowledge acquirement.         3       Study outcomes and reference to the educational results for a field of study         Knowledge:       1. student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments systems comprising intechnical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W06]         3. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]         2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical sol  |  | Technical scie   | ences                          |  | 2 100%                    |  |  |  |
| Knowledge         Knowledge of physics, mathematics, electronics, mechanics, optics and vacuum technology at<br>the Technical Physics undergraduate course level. Basic knowledge of engineering graphics.           2         Skills         Skill in physical problem solving, skill in acquiring information from listed sources, ability to<br>make engineering drawing. Skill in using of CAD programs.           3         Social<br>competencies         Understanding the necessity of personal competence development.           1. Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary<br>systems from selected fields of physics.         2. Development of skills in knowledge of physics application to solving problems connected to construction an configuration of<br>scientific instruments systems.           3. Development of self-reliance in knowledge acquirement.         Study outcomes and reference to the educational results for a field of study           Knowledge:         1.         Student, who has completed the course, is able to select proper mathematical model for describing physical effects related<br>to basis of selected scientific instruments operation [K_W01]           2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems<br>comprising technical solution of diverse branches of engineering? optics, electronics and mechanics [K_W05]           3. Student, who has completed the course, is able to describe the process of constructing complex research systems,<br>including technology implementation process [K_W06, K_W12, K_W13]  | dr Andrzej Jarosz<br>email: andrzej.jarosz@put.poznan.pl<br>tel. 61 6653226<br>Faculty of Technical Physics  |  |                                |  |                           |  |  |  |
| Knowledge         the Technical Physics undergraduate course level. Basic knowledge of engineering graphics.           Skills         Skill in physical problem solving, skill in acquiring information from listed sources, ability to make engineering drawing. Skill in using of CAD programs.           Bocial competencies         Understanding the necessity of personal competence development.           Assumptions and objectives of the course:         1. Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fields of physics.           Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments systems.           Development of self-reliance in knowledge acquirement.           Study outcomes and reference to the educational results for a field of study           Knowledge:           1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]           2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]           3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process [K_W06, K_W12, K_W13]  | Prerequisites in terms of knowledge, skills and social competencies:   |  |                                |  |                           |  |  |  |
| 2       Skills       make engineering drawing. Skill in using of CAD programs.         3       Social competencies       Understanding the necessity of personal competence development.         Assumptions and objectives of the course:       1. Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fields of physics.         2. Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments systems.         3. Development of self-reliance in knowledge acquirement.         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]         2. Student, who has completed the course, is able to describe the process of construction and mechanics [K_W05]         3. Student, who has completed the course, is able to describe the process of constructing complex research systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]         3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process [K_W06, K_W12, K_W13]  | 1  | Knowledge  |                                |  |                           |  |  |  |
| S       Competencies         Assumptions and objectives of the course:         1. Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fields of physics.         2. Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments systems.         3. Development of self-reliance in knowledge acquirement.         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]         2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]         3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13]  | 2  | Skills   |                                |  |                           |  |  |  |
| <ol> <li>Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fields of physics.</li> <li>Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments systems.</li> <li>Development of self-reliance in knowledge acquirement.</li> <li>Study outcomes and reference to the educational results for a field of study</li> <li>Knowledge:         <ul> <li>Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]</li> <li>Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]</li> <li>Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13]</li> </ul> </li> </ol>  | 3  |  | Understanding the necessity of | personal competence developr                     | nent.                     |  |  |  |
| systems from selected fields of physics. 2. Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments systems. 3. Development of self-reliance in knowledge acquirement.  Study outcomes and reference to the educational results for a field of study  Knowledge:  1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01] 2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05] 3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process [K_W06, K_W12, K_W13]  | Assu   | mptions and obj  | ectives of the course:         |  |                           |  |  |  |
| scientific instruments systems. 3. Development of self-reliance in knowledge acquirement.  Study outcomes and reference to the educational results for a field of study  Knowledge:  1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]  2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]  3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13]   | 1. Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fields of physics.  |  |                                |  |                           |  |  |  |
| Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]         2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]         3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13]  | 2. Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments systems.   |  |                                |  |                           |  |  |  |
| <ul> <li>Knowledge:</li> <li>1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]</li> <li>2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]</li> <li>3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13]</li> </ul>  | 3. Development of self-reliance in knowledge acquirement.  |  |                                |  |                           |  |  |  |
| <ol> <li>Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]</li> <li>Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]</li> <li>Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13]</li> </ol>   | Study outcomes and reference to the educational results for a field of study   |  |                                |  |                           |  |  |  |
| to basis of selected scientific instruments operation [K_W01]<br>2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems<br>comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]<br>3. Student, who has completed the course, is able to describe the process of constructing complex research systems,<br>including technology implementation process comprising intellectual property resources management and to define selected<br>elements of project preparation process [K_W06, K_W12, K_W13]   | Knowledge:   |  |                                |  |                           |  |  |  |
| comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05]<br>3. Student, who has completed the course, is able to describe the process of constructing complex research systems,<br>including technology implementation process comprising intellectual property resources management and to define selected<br>elements of project preparation process [K_W06, K_W12, K_W13]   | 1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation [K_W01]  |  |                                |  |                           |  |  |  |
| 3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13]   | 2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics [K_W05] |  |                                |  |                           |  |  |  |
|  | 3. Stud<br>includir  | 3. Student, who has completed the course, is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process [K_W06, K_W12, K_W13] |                                |  |                           |  |  |  |
|  | Skills   |  |                                | -  |                           |  |  |  |

1. Student, who has completed the course, is able to use mathematical knowledge to characterize quantitatively parameters of measuring instruments and to model their operation. - [K\_U01]

2. Student, who has completed the course, is able to extract information on technologies useful in scientific instruments construction from the literature, databases and other sources. - [K\_U02]

3. Student, who has completed the course, is able to prepare design documentation and specification sheet of selected research instruments and systems. - [K\_U06, K\_U10, K\_U11, K\_U16, K\_U18]

4. Student, who has completed the course, is able to define application areas of scientific and test instruments, considering importance for the streamlining of production process and products quality improvement. - [K\_U22]

### Social competencies:

1. Student, who has completed the course, understands the need of continuous self-improvement raising his or her professional competences because of fast development of technology applied to measuring apparatus. - [K\_K04]

2. Student, who has completed the course, understands the need of informing the society about new developments of scientific and test apparatus, because of potential applications in the fields important from the public interest point of view, like environmental protection and health care. - [K\_K08]

### Assessment methods of study outcomes

W01, W02, W03, U04, K02

Assessment of knowledge and skills demonstrated in written work during the last lecture in semester on the grounds of scored points:

3,0 50.1%-70.0%

4.0 70.1%-90.0%

5,0 from 90.1%

U01, U02, U03, K01

Assessment on the grounds of written design documentation:

- assessment of construction assumptions, including correctness of mathematical model choice, the way of chosen model application and quality of results presentation,

- assessment of collected information concerning technologies, elements and sub-assemblies useful for the project completion,

- sources of information search invention assessment,

- assessment of project documentation from the point of view of information completeness, technical solutions presentation quality and design documentation correctness.

# Course description

1. Fundamentals of signal theory - signal parameters. Basics of digital signal processing.

2. Noise and interference in measuring signal processing systems. Techniques of noise and interference reduction.

3. Electronic measuring instruments - construction, parameters and applications.

4. Advanced techniques of optical spectroscopy - review of scientific instruments construction. Atomic absorption spectroscopy, Fourier transform spectroscopy, absorption and emission laser spectroscopy, Raman laser spectroscopy, optical-microwave double resonance.

5. Apparatus for time-domain laser spectroscopy.

6. Radiofrequency spectroscopy apparatus - review. Components and systems utilized in construction of radiofrequency spectrometers. Generation of magnetic field. Masers.

7. Mass spectrometers - construction and operation.

8. Scientific apparatus combining multiple measuring techniques.

### Basic bibliography:

1. Building Scientific Apparatus, J.H. Moore, Ch.C. Davis, M.A. Coplan, Cambridge University Press 2009

2. Spektroskopia laserowa, W. Demtroeder, Wydawnictwo Naukowe PWN, Warszawa 1993

3. Instrumenty optyczne, F. Ratajczyk, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002

4. Elektronika w laboratorium naukowym, T. Stacewicz, A. Kotlicki, Wydawnictwo Naukowe PWN, Warszawa 1994

5. Sztuka elektroniki, P. Horowitz, W. Hill, Wydawnictwa Komunikacji i Łączności, Warszawa 2001

6. Wstęp do spektroskopii rezonansów magnetycznych, J. Stankowski, W. Hilczer, Wydawnictwo Naukowe PWN, Warszawa 2005

7. Mikrofale. Układy i systemy, J. Szóstka, Wydawnictwa Komunikacji i Łączności, Warszawa 2006

# Additional bibliography:

1. Practical Optics, N. Menn, Elsevier Academic Press, Boston 2004

2. Fizyka doświadczalna, T. 1 - 6, S. Szczeniowski, Państwowe Wydawnictwo Naukowe 1983

| Result of average stu                             | dent's workload      |      |
|---|----------------------|------|
| Activity  | Time (working hours) |      |
| 1. Participation in lectures                      |                      | 30   |
| 2. Participation in consultations about a project | 3                    |      |
| 3. Making of a project                            | 20                   |      |
| 4. Preparation for an exam                        | 12                   |      |
| Student's wo                                      | orkload              |      |
| Source of workload                                | hours                | ECTS |
| Total workload                                    | 65                   | 2    |
| Contact hours                                     | 33                   | 1    |
| Practical activities                              | 23                   | 1    |