

## DESCRIPTION OF THE COURSE OF STUDY

|                       |                  |                           |
|-----------------------|------------------|---------------------------|
| Course code           | 0533.6.FIZ2.D.SE |                           |
| Name of the course in | Polish           | Spektroskopia elektronowa |
|                       | English          | Electron spectroscopy     |

## 1. LOCATION OF THE COURSE OF STUDY WITHIN THE SYSTEM OF STUDIES

|                                                |                           |
|------------------------------------------------|---------------------------|
| 1.1. Field of study                            | Physics                   |
| 1.2. Mode of study                             | full-time studies         |
| 1.3. Level of study                            | second level              |
| 1.4. Profile of study*                         | General academic          |
| 1.5. Person/s preparing the course description | prof. dr hab. Marek Pajek |
| 1.6. Contact                                   | marek.pajek@ujk.edu.pl    |

## 2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

|                              |                                      |
|------------------------------|--------------------------------------|
| 2.1. Language of instruction | English                              |
| 2.2. Prerequisites*          | Structure of matter (Budowa materii) |

## 3. DETAILED CHARACTERISTICS OF THE COURSE OF STUDY

|                         |                                   |                                                                                                                      |
|-------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------|
| 3.1. Form of classes    | Lectures (L), labs (LAB)          |                                                                                                                      |
| 3.2. Place of classes   | UJK buildings                     |                                                                                                                      |
| 3.3. Form of assessment | Credit with a grade               |                                                                                                                      |
| 3.4. Teaching methods   | Lectures and laboratory exercises |                                                                                                                      |
| 3.5. Bibliography       | Required reading                  | S. Hüfner, <i>Photoelectron spectroscopy</i> (Springer, 1995)                                                        |
|                         | Further reading                   | P. van der Heide, <i>X-ray Photoelectron Spectroscopy. An Introduction to Principles and Practice</i> , (Wiley 2012) |

## 4. OBJECTIVES, SYLLABUS CONTENT AND INTENDED LEARNING OUTCOMES

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>4.1. Course objectives (including form of classes):</b><br>Lectures and labs<br>C1. Description of principles of electron spectroscopy<br>C2. Description of basic experimental aspects (electron sources and spectrometers, ultrahigh vacuum instruments)<br>C3. Description of basic techniques of electron spectroscopy<br>C4. Presentation of applications of electron spectroscopy in material sciences                                                                                         |  |
| <b>4.2. Detailed syllabus (including form of classes)</b><br>Lectures and labs<br>1. Interaction of electrons with matter<br>2. Electron guns and electron spectrometers<br>3. Photoelectron spectroscopy (XPS, UPS, ARPES)<br>4. Inverse photoelectric effect and its applications (IPES, BIS)<br>5. Auger electron spectroscopy (AES, BAES)<br>6. Scanning electron microscopy (SEM, SAM)<br>7. Diffraction of electrons (LEED, RHEED)<br>8. Applications of electron spectroscopy in surface physics |  |

## 4.3 Intended learning outcomes

| Code                                         | A student, who passed the course                                                                                     | Relation to learning outcomes |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------------|
| within the scope of deepen <b>KNOWLEDGE:</b> |                                                                                                                      |                               |
| W01                                          | Knows basic physical concepts of electron spectroscopy and its applications in material sciences                     | FIZ2A_W01<br>FIZ2A_W02        |
| W02                                          | Knows selected experimental techniques of electron spectroscopy                                                      | FIZ2A_W06<br>FIZ2A_W11        |
| W03                                          | Knows application of electron spectroscopy for determination of electronic structure and characteristics of surfaces | FIZ2A_W02<br>FIZ2A_W06        |
| within the scope of deepen <b>ABILITIES:</b> |                                                                                                                      |                               |
| U01                                          | Can find appropriate methods of electron spectroscopy for investigations of properties of materials                  | FIZ2A_U02                     |

|                                               |                                                                                                               |           |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------|
| U02                                           | Can explain the fundamentals of different techniques of electron spectroscopy                                 | FIZ2A_U02 |
| U03                                           | Can interpret the experimental results obtained by using techniques of electron spectroscopy                  | FIZ2A_U03 |
| U04                                           | Can described the measured properties of materials                                                            | FIZ2A_U03 |
| within the scope of <b>SOCIAL COMPETENCE:</b> |                                                                                                               |           |
| K01                                           | Is ready to recognize the importance of electron spectroscopy in the investigation of materials and surfaces. | FIZ2A_K04 |

| 4.4. Methods of assessment of the intended learning outcomes |                            |   |     |                 |   |     |                 |   |             |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
|--------------------------------------------------------------|----------------------------|---|-----|-----------------|---|-----|-----------------|---|-------------|------------------|---|-----|-----------------|---|-----|-----------------|---|-----|---------------------------------------------------|---|-----|--|
| Teaching outcomes<br>(code)                                  | Method of assessment (+/-) |   |     |                 |   |     |                 |   |             |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
|                                                              | Exam oral/written*         |   |     | Test*           |   |     | Project*        |   |             | Effort in class* |   |     | Self-study*     |   |     | Group work*     |   |     | Others* e.g. standardized test used in e-learning |   |     |  |
|                                                              | Form of classes            |   |     | Form of classes |   |     | Form of classes |   |             | Form of classes  |   |     | Form of classes |   |     | Form of classes |   |     | Form of classes                                   |   |     |  |
|                                                              | L                          | C | ... | L               | C | ... | L               | C | L<br>a<br>b | L                | C | ... | L               | C | ... | L               | C | ... | L                                                 | C | ... |  |
| W01                                                          |                            |   |     |                 |   |     | +               |   | +           |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
| W02                                                          |                            |   |     |                 |   |     | +               |   | +           |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
| W03                                                          |                            |   |     |                 |   |     | +               |   | +           |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
| U01                                                          |                            |   |     |                 |   |     | +               |   | +           |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
| U02                                                          |                            |   |     |                 |   |     | +               |   | +           |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
| U03                                                          |                            |   |     |                 |   |     | +               |   | +           |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
| U04                                                          |                            |   |     |                 |   |     | +               |   | +           |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |
| K01                                                          |                            |   |     |                 |   |     | +               |   |             |                  |   |     |                 |   |     |                 |   |     |                                                   |   |     |  |

| 4.5. Criteria of assessment of the intended learning outcomes |       |                                                  |
|---------------------------------------------------------------|-------|--------------------------------------------------|
| Form of classes                                               | Grade | Criterion of assessment                          |
| lecture (L)                                                   | 3     | when <50 - 60)% of required effects is achieved  |
|                                                               | 3,5   | when <60 - 70)% of required effects is achieved  |
|                                                               | 4     | when <70 - 80)% of required effects is achieved  |
|                                                               | 4,5   | when <80 - 90)% of required effects is achieved  |
|                                                               | 5     | when <90 - 100)% of required effects is achieved |
| Labs                                                          | 3     | when <50 - 60)% of required effects is achieved  |
|                                                               | 3,5   | when <60 - 70)% of required effects is achieved  |
|                                                               | 4     | when <70 - 80)% of required effects is achieved  |
|                                                               | 4,5   | when <80 - 90)% of required effects is achieved  |
|                                                               | 5     | when <90 - 100)% of required effects is achieved |

## 5. BALANCE OF ECTS CREDITS – STUDENT'S WORK INPUT

| Category                                                                     | Student's workload |                    |
|------------------------------------------------------------------------------|--------------------|--------------------|
|                                                                              | Full-time studies  | Extramural studies |
| NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/ | 30                 |                    |
| Participation in lectures*                                                   | 20                 |                    |
| Participation in classes, seminars, laboratories*                            | 10                 |                    |
| INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/                           | 20                 |                    |
| Preparation for the laboratories                                             | 10                 |                    |
| Preparation of the project                                                   | 10                 |                    |
| TOTAL NUMBER OF HOURS                                                        | 50                 |                    |
| ECTS credits for the course of study                                         | 2                  |                    |

\*delete as appropriate

**Accepted for execution** (date and legible signatures of the teachers running the course in the given academic year)

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