

**AGH**AGH UNIVERSITY OF SCIENCE  
AND TECHNOLOGY

Module name: Introduction to Dislocation Theory

Academic year: 2019/2020 Code: ZSDA-3-0156-s ECTS credits: 3

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: prof. Hamilton Carter (hamiltbc@miamioh.edu)

### Module summary

This course presents advanced concepts in the mechanical behavior of materials with a focus on dislocations in structural metals, including Shockley partial dislocations, Frank partial dislocations and Lomer/Cottrell dislocations. The course discusses the elastic properties of dislocations, their motion in crystal lattices and their interaction with crystallographic and microstructural features. The influence of dislocations on material, mechanical and fracture properties is emphasized. Mechanisms for the origin and multiplication of dislocations are also studied with an overview on the characterization methods, e.g. transmission electron microscopy, employed to analyze them

### Description of learning outcomes for module

| MLO code                            | Student after module completion has the knowledge/ knows how to/is able to  | Connections with FLO | Method of learning outcomes verification (form of completion) |
|-------------------------------------|---|----------------------|---|
| Social competence: is able to       |   |                      |   |
| M_K001                              | Student ...   | SDA3A_K01            |   |
| Skills: he can                      |   |                      |   |
| M_U001                              | Student can derive the stress/strain fields associated with dislocations and assess their influence on mechanical and fracture behavior                               | SDA3A_U01            |   |
| M_U002                              | Student can model the motion of dislocations as they interact with crystallographic features, e.g. stacking faults and twins, that promote dislocation jogs and climb | SDA3A_U01            |   |
| Knowledge: he knows and understands |   |                      |   |
| M_W001                              | Student has a basic knowledge on crystal structures   | SDA3A_W01            | Examination   |

|        |  |           |  |
|--------|--|-----------|--|
| M_W002 | Student knows how to derive the stress/strain fields associated with dislocations and assess their influence on mechanical and fracture behavior | SDA3A_W01 |  |
|--------|--|-----------|--|

## Number of hours for each form of classes

| Suma | Form of classes |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
|------|-----------------|--------------------|--------------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------|-------------------------------|----------|
|      | Lectures        | Auditorium classes | Laboratory classes | Project classes | Conversation seminar | Seminar classes | Practical classes | Fieldwork classes | Workshops | Prace kontrolne i przejściowe | Lektorat |
| 30   | 15              | 15                 | 0                  | 0               | 0                    | 0               | 0                 | 0                 | 0         | 0                             | 0        |

## FLO matrix in relation to forms of classes

| MLO code                            | Student after module completion has the knowledge/ knows how to/is able to  | Form of classes |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
|-------------------------------------|---|-----------------|--------------------|--------------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------|-------------------------------|----------|
|                                     |   | Lectures        | Auditorium classes | Laboratory classes | Project classes | Conversation seminar | Seminar classes | Practical classes | Fieldwork classes | Workshops | Prace kontrolne i przejściowe | Lektorat |
| Social competence: is able to       |   |                 |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
| M_K001                              | Student ....  | +               | +                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |
| Skills: he can                      |   |                 |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
| M_U001                              | Student can derive the stress/strain fields associated with dislocations and assess their influence on mechanical and fracture behavior                               | -               | +                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |
| M_U002                              | Student can model the motion of dislocations as they interact with crystallographic features, e.g. stacking faults and twins, that promote dislocation jogs and climb | -               | +                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |
| Knowledge: he knows and understands |   |                 |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
| M_W001                              | Student has a basic knowledge on crystal structures   | +               | +                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |
| M_W002                              | Student knows how to derive the stress/strain fields associated with dislocations and assess their influence on mechanical and fracture behavior                      | -               | +                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |

## Student workload (ECTS credits balance)

| Student activity form   | Student workload |
|---|------------------|
| Udział w zajęciach dydaktycznych/praktyka                         | 30 h             |
| Preparation for classes   | 30 h             |
| przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania | 20 h             |
| Realization of independently performed tasks                      | 20 h             |
| Examination or Final test   | 2 h              |
| Contact hours   | 5 h              |
| Summary student workload  | 107 h            |
| Module ECTS credits   | 3 ECTS           |

## Additional information

### Module content

#### Lectures

This course presents advanced concepts in the mechanical behavior of materials with a focus on dislocations in structural metals, including Shockley partial dislocations, Frank partial dislocations and Lomer/Cottrell dislocations. The course discusses the elastic properties of dislocations, their motion in crystal lattices and their interaction with crystallographic and microstructural features. The influence of dislocations on material, mechanical and fracture properties is emphasized. Mechanisms for the origin and multiplication of dislocations are also studied with an overview on the characterization methods, e.g. transmission electron microscopy, employed to analyze them.

#### Auditorium classes

-

#### Teaching methods and techniques:

Lectures: Presentation, discussion

Auditorium classes: Presentation,

#### Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

According to the Student Handbook, a student may withdraw from a full-semester course through the ninth calendar week of the semester. After the end of the ninth week, a student may not withdraw from a course unless the Interdivisional Committee of Advisers approves a petition.

#### Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:

- Attendance is mandatory: Yes
- Participation rules in classes: 1. Lecture attendance is required.

2. Lecture will begin promptly at the scheduled time.
3. On time attendance counts as 100%; late attendance as 50%; absence as 0%.
4. More than 15 minutes late counts as an absence.
5. No make-up tests will be given for unexcused absences.
6. University policy concerning academic honesty will be strictly enforced.

Auditorium classes:

- Attendance is mandatory: Yes
  - Participation rules in classes: 1. Lecture attendance is required.
2. Lecture will begin promptly at the scheduled time.
  3. On time attendance counts as 100%; late attendance as 50%; absence as 0%.
  4. More than 15 minutes late counts as an absence.
  5. No make-up tests will be given for unexcused absences.
  6. University policy concerning academic honesty will be strictly enforced.

### **Method of calculating the final grade**

Grade Composition and Range

Exam 120%

Exam 220%

Final 20%

Homework/Projects 35%

Attendance 5%

### **Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:**

According to the Student Handbook, a student may withdraw from a full-semester course through the ninth calendar week of the semester. After the end of the ninth week, a student may not withdraw from a course unless the Interdivisional Committee of Advisers approves a petition.

### **Prerequisites and additional requirements**

Basic materials science

### **Recommended literature and teaching resources**

Reference Texts

- Essentials of Materials Science and Engineering, Donald R. Askeland and Wendelin J. Wright, 3rd Edition, Cengage Learning, 2014
- Mechanical Behavior of Materials, Thomas H. Courtney, Waveland Press, Inc., 2nd Edition, 2000
- Elementary Dislocation Theory, Johannes Weertman and Julia Weertman, Oxford University Press, 2nd edition, 1992

### **Scientific publications of module course instructors related to the topic of the module**

Additional scientific publications not specified

### **Additional information**

None