

**AGH**AGH UNIVERSITY OF SCIENCE  
AND TECHNOLOGY

Module name: Paraseismic influence on the environment

Academic year: 2019/2020 Code: GIPZ-2-313-LM-s ECTS credits: 3

Faculty of: Mining and Geoengineering

Field of study: - Specialty: Lean Manufacturing

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

Lecture language: English Profile of education: Academic (A) Semester: 3

Course homepage: —

Responsible teacher: dr inż. Pyra Józef (pyra@agh.edu.pl)

### Module summary

The student understands the problem of the impact of vibrations induced from various sources in the aspect of impact on building structures.

### 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	The student can make engineer projects or fulfilled various team tasks. The student is able to work in group where he realizes group tasks or individual task.	IPZ2A_K01, IPZ2A_K02	Activity during classes, Presentation
Skills: he can			
M_U001	The student can: perform measurements, conduct analyses of the intensity of the ground vibration. The student can present obtained results.	IPZ2A_U03	Scientific paper
M_U002	The student can make the assessment of blasting works influences on the environment. The student can determine the boundary conditions of blasting parameters.	IPZ2A_U03	Test, Presentation
M_U003	The student can conduct the seismic signal analysis by taking into consideration various methods of seismic signal processing.	IPZ2A_U03	Activity during classes, Test, Presentation
Knowledge: he knows and understands			

M_W001	The student has a basic knowledge about explosives use in civil purpose.	IPZ2A_W02	Presentation
M_W002	The student has a principal knowledge about measurements standards. The student can formulate the results of field measurements.	IPZ2A_W02	Test
M_W003	The student has a principal knowledge about the assessment of the ground vibration on the housing structure.	IPZ2A_W02	Test
M_W004	The student has a principal knowledge about the seismic signal processing methods	IPZ2A_W02	Test

## 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	The student can make engineer projects or fulfilled various team tasks. The student is able to work in group where he realizes group tasks or individual task.	-	+	-	-	-	-	-	-	-	-	-
Skills: he can												
M_U001	The student can: perform measurements, conduct analyses of the intensity of the ground vibration. The student can present obtained results.	+	+	-	-	-	-	-	-	-	-	-
M_U002	The student can make the assessment of blasting works influences on the environment. The student can determine the boundary conditions of blasting parameters.	+	+	-	-	-	-	-	-	-	-	-

M_U003	The student can conduct the seismic signal analysis by taking into consideration various methods of seismic signal processing.	+	+	-	-	-	-	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	The student has a basic knowledge about explosives use in civil purpose.	+	+	-	-	-	-	-	-	-	-	-
M_W002	The student has a principal knowledge about measurements standards. The student can formulate the results of field measurements.	+	+	-	-	-	-	-	-	-	-	-
M_W003	The student has a principal knowledge about the assessment of the ground vibration on the housing structure.	+	+	-	-	-	-	-	-	-	-	-
M_W004	The student has a principal knowledge about the seismic signal processing methods	+	+	-	-	-	-	-	-	-	-	-

## Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	30 h
Preparation for classes	15 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	25 h
Realization of independently performed tasks	15 h
Examination or Final test	2 h
Contact hours	1 h
Summary student workload	88 h
Module ECTS credits	3 ECTS

## Additional information

### Module content

#### Lectures

#### 1. Intorduction to explosive materials

- Properties of explosives and blasting agents (Low and High explosives, Primary and Secondary explosives, construction and various types of charges)

#### 2. Physical and chemical properties of explosives

- Determination of oxygen balance
  - Rules of explosive's decomposition
  - Determination of post shoot gases energy
  - Shock wave and acoustic wave properties
3. Detonation and rock breakage mechanism
- principle of detonation and breakage
  - rock breakage, zones formation
4. Prediction and control of ground vibrations
- the measurement equipment
  - ground vibration assessment
5. Influence of blasting on surface structure and underground structure
- Surface blasting - underground effects
  - Underground blasting - underground effects
  - Evaluation of tremors energy. The GSI scale.
  - The Arias integral
  - The paraseismic influence of demolition works on the environment
6. The influence of transport vibration and machine vibration on housing structures
- differences in the time and frequency domain
  - the impact of non - blasting ground vibration on housing structure (differences in assessment)

**Auditorium classes**

Mathematical methods of ground vibration analyses in the time and frequency domain

- Fast Fourier Transforma, Short Time Fourier Transform, Walvet Transform, Matching Pursuit analysis

Structural response of Surface structure to the ground born vibration

- Formation of the low frequency vibration
- Effect of repeated blasting works to housing structure
- Respond spectrum

- Studies on the residential and industrial structures

The assessment of the human response to the ground born vibration

### **Teaching methods and techniques:**

Lectures: Treści prezentowane na wykładzie są przekazywane w formie prezentacji multimedialnej w połączeniu z klasycznym wykładem tablicowym wzbogaconymi o pokazy odnoszące się do prezentowanych zagadnień.

Auditorium classes: Podczas zajęć audytoryjnych studenci na tablicy rozwiązują zadane wcześniej problemy. Prowadzący na bieżąco dokonuje stosowanych wyjaśnień i moderuje dyskusję z grupą nad danym problemem.

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

Final mark on the basis of test in written form of lecture, auditory exercises marks.

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

Lectures:

- Attendance is mandatory: No

- Participation rules in classes: Studenci uczestniczą w zajęciach poznając kolejne treści nauczania zgodnie z sylabusem przedmiotu. Studenci winni na bieżąco zadawać pytania i wyjaśniać wątpliwości. Rejestracja audiowizualna wykładu wymaga zgody prowadzącego.

Auditorium classes:

- Attendance is mandatory: Yes

- Participation rules in classes: Studenci przystępując do ćwiczeń są zobowiązani do przygotowania się w zakresie wskazanym każdorazowo przez prowadzącego (np. w formie zestawów zadań). Ocena pracy studenta może bazować na wypowiedziach ustnych lub pisemnych w formie kolokwium, co zgodnie z regulaminem studiów AGH przekłada się na ocenę końcową z tej formy zajęć.

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

The final grade is the weighted average of lecture ratings (weight 0.5), auditorium classes (weight 0.5).

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

Attendance at auditorium exercises is mandatory. After the absence student is obliged to attend missed classes with another group or perform additional studies in writing on a topic related to the abandoned classes.

### **Prerequisites and additional requirements**

lack

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

1. Olofsson S.O. 1990. Applied explosives technology for construction and mining. Edition 2. Publisher APPLEX.

2. Akhavan J. 2011. The chemistry of explosives. Royal Society of Chemistry. Third Edition, New edition edition.

3. Cooper P. 1996. Explosives engineering. Wiley-VCH. First edition

4. Pal Roy P. 2005. Rock blasting effects and operations. A.A. Balkema publishers

5. Dowding C.H. 2000. Construction Vibrations, International Society of Explosives
6. Gupta A.K. 1993. Response spectrum method in seismic analysis and design of structures. CRC Press.

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

1. Determining acceptable explosive charge mass under different geological conditions — Problematyka wyznaczania dopuszczalnych ładunków MW w zróżnicowanych warunkach geologicznych / Józef PYRA, Anna SOŁTYS, Jan WINZER, Michał DWORZAK, Andrzej BIESSIKIRSKI // Archives of Mining Sciences = Archiwum Górnictwa ; ISSN 0860-7001. — 2015 vol. 60 no. 3, s. 825-845. — Bibliogr. s. 844-845
2. Research review of the influence of millisecond delay on intensity and structure of vibrations induced with blasting works in Polish strip mines — Przegląd badań nad wpływem opóźnienia milisekundowego na intensywność i strukturę drgań wzbudzanych robotami strzałowymi w polskich kopalniach odkrywkowych / Józef PYRA // AGH Journal of Mining and Geoengineering ; ISSN 2299-257X. — Tytuł poprz.: Górnictwo i Geoinżynieria ; ISSN: 1732-6702. — 2013 vol. 37 no. 1, s. 81-91
3. Various methods of the ground vibration assessment / Andrzej BIESSIKIRSKI, Józef PYRA, Michał DWORZAK // W: Proceedings of the forty-first annual conference on explosives and blasting technique : February 1-4, 2015, New Orleans, LA USA / International Society of Explosive Engineers. — USA : ISEE, cop. 2015. — S. 403-412

### **Additional information**

Attendance at auditorium exercises is mandatory. After the absence student is obliged to attend missed classes with another group or perform additional studies in writing on a topic related to the abandoned classes. Students are allowed to approach a final exam of auditorium exercises three times . A positive final grade can be corrected in specified circumstances. Attendance at lectures is recommended.