AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Structural Health Monitoring

Academic year: 2019/2020 Code: ZSDA-3-0117-s ECTS credits: 4

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: http://krim.agh.edu.pl/wstaszewski/

Responsible teacher: prof. dr hab. inż. Staszewski Wiesław (w.j.staszewski@agh.edu.pl)

Module summary

Most engineering structures (in aerospace, transportation, civil engineering) require reliable damage detection methods to guarantee safe operation. Structural Health Monitoring offers real-time monitoring thanks to permanently attached sensors. This interdisciplinary course discusses recent advancements in detection techniques, sensor technology, data processing and is dedicated to all engineers interested in maintenance, reliability, non-destructive testing of materials or smart 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	Team working and discussion skills	SDA3A_K01, SDA3A_K02	Involvement in teamwork
Skills: he can			
M_U001	Students will develop critical assesments skills related to various available methods and technologies. Team working, reporting/presentation skills, discussion skills will be also an important part of the course.	SDA3A_W03, SDA3A_W02, SDA3A_U02, SDA3A_W05, SDA3A_U05, SDA3A_U01, SDA3A_W01	Activity during classes
Knowledge: he knows and understands			

M_W001	Students will hav a chance to gather knowledge related to: (1) material defects, structural damage and failures, (2) recent damage detection/monitoring techniques, (3) new trends in Structural Health Monitoring	SDA3A_W02, SDA3A_W07, SDA3A_W05, SDA3A_W01	Report
M_W002	Critical review of selected structural health monitorinh problem	SDA3A_W03, SDA3A_W07, SDA3A_W01	Report

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
40	20	0	0	0	0	20	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	Team working and discussion skills	-	-	-	-	-	+	-	-	-	-	-
Skills: he can												
M_U001	Students will develop critical assesments skills related to various available methods and technologies. Team working, reporting/presentation skills, discussion skills will be also an important part of the course.	-	-	-	-	-	+	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Students will hav a chance to gather knowledge related to: (1) material defects, structural damage and failures, (2) recent damage detection/monitoring techniques, (3) new trends in Structural Health Monitoring	+	-	-	-	-	+	-	-	-	-	-

M_W002	Critical review of selected structural health monitorinh problem	-	-	-	-	-	+	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	40 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	10 h
Realization of independently performed tasks	20 h
Contact hours	5 h
Summary student workload	75 h
Module ECTS credits	4 ECTS

Additional information

Module content

Lectures

Structural Health Monitoring
The lectures will cover the following research and engineering topics:

1.Introduction to Health Monitoring, Part I – structural design, structural damage, maintenance, NDT/E, condition monitoring, structural health monitoring
2.Introduction to Health Monitoring, Part II – various approaches to health monitoring: inspection, load monitoring, damage monitoring, NDT/E
3.Usage Monitoring – aerospace approach, flight parameters, strain monitoring, novel approaches
4.NDT/E for structural damage detection, Part I – visual inspection, acoustic emission, eddy current, x-ray, shearography and thermography
5.NDT/E for structural damage detection, Part II – ultrasonic testing
6.Condition Monitoring, part I –vibration based techniques
7.Condition Monitoring, part II – application examples, rotating machinery
8.Structural Health Monitoring based on vibration analysis
9.Impact damage detection in composite structures
10.Leakage detection in pipeline networks
11.Guided ultrasonic waves for structural health monitoring
12.Damage detection with Lamb waves, Part I – application examples
13.Damage detection with Lamb waves, Part II – application examples
14. Nonlinear acoustics for structural damage detection, Part I – classical approaches
15. Nonlinear acoustics for structural damage detection, Part II – non-classical approaches
16.Smart sensor technologies for health monitoring – piezoelectric sensors, optical fibre sensors, non-contact measurements with lasers
17. Advanced data processing for structural damage detection
18. Wavelet analysis for damage detection applications

19-20.Advanced and novel approaches for structural health monitoring

Seminar classes

Structural Health Monitoring lectures

Seminars will be based on students presentations followed by critical discussions. The topics for presentations and discussions will be related to the lecture course. Students will have an opportunity to bring their own problems related to Structural Health Monitoring.

Teaching methods and techniques:

Lectures: The course will involve 20 hours of lectures based on most up to date research developments and industrial case studies. Teaching by research will be the major focus of the course.
Seminar classes: This part of the course will involves 20 hours of seminars. The major focus will be on student presentations, analysis of literature and real engineering case studies, critical discussion.

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

Course assessment will be based on seminar attendance, short report and presentation, active participation in discussions. Different topics will be selected for reports and presentations. The reports will be produced individually but presentations will be delivered by a team of maximum 2-3 students.

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

Lectures:
– Attendance is mandatory: No
– Participation rules in classes: Student’s presence in lectures will not be obligatory.
Seminar classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Participation in seminars will be essential for the final assessment.

Method of calculating the final grade

The final mark will be the average mark from: (1) short report, (2) presentation and (3) active involvement in seminar discussions.

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

The delivery of reports and presentations will be obligatory. However, if – due to unexpected circumstances – - participation in seminars and delivery of reports/presentations will not be possible, the students will have an opportunity to arrange new deadlines for reports, presentations. Critical studies of selected research articles will also be possible to catch up with the course and assessment.

Prerequisites and additional requirements

Basic A-level and undergraduate knowledge of mathematics and physics will be needed. The course is multidisciplinary and no basic knowledge is required from a specific engineering area. Students with any engineering degree and/or university degree from mathematics/physics will have a chance to complete the course.

Recommended literature and teaching resources

Possible book literature includes the following items:

R.M. Measures, 2001, Structural Health Monitoring with Fiber Optic Technology, Academic Press, San Diego, USA.
W.J. Staszewski, C. Boller and G.R. Tomlinson, Eds, 2004, Health Monitoring of Aerospace Structures,

Wiley, Chichester, UK.
D. Balageas, C.-P. Fritzen and A. Guemes, Eds, 2006, Structural Health Monitoring, ISTE Ltd. London, UK.
D.E. Adams, 2007, Health Monitoring of Structural Materials and Components, Wiley, Chichester, UK.
C. Boller, F.-K. Chang and Y. Fujino, Eds., 2009, Encyclopedia of Structural Health Monitoring, Wiley, Chichester, UK
T. Stepinski, T. Uhl and W.J. Staszewski, Eds, 2013, Advanced Structural Damage Detection, Wiley, Chichester, UK

In addition the study of the following journals – that cover recent advancements in the field – will be helpful:
Structural Health Monitoring, Structural Control and Health Monitoring, Smart Materials and Structures, Mechanical Systems and Signal Processing, Journal of Sound and Vibration, Journal of Nondestructive Evaluation, Journal of Ultrasonics, Composite Science and Technology, Composites Part A and B, Journal of Intelligent Material Systems and Structures, Journal of Nondestructive Testing and Evaluation, Journal of the Americal Society of Acoustics.

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

The lecturer is one of the most active researchers in the filed with proven record of research funding, industrial collaboration worldwide (UK, Germany, France, Italy, China, Korea, Poland), research publications (nearly 500 research articles including 22 book contributions and over 140 Impact Factor papers), international patents and substantial number of citations. The most important publications can be found on the Web of Science.

Additional information

None