AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Phenomenological Thermodynamics

Academic year: 2019/2020 Code: ZSDA-3-0110-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: —

Responsible teacher: dr hab. inż. Fornalik-Wajs Elżbieta (elaf@agh.edu.pl)

Module summary

The module develops a knowledge of fundamental thermodynamic concepts. The irreversible thermodynamics will be the basis for an analysis of the real processes and the research problems. The module will help to extend the view on the processes occuring in the complex systems with an emphasize on the conjugated ones.

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	understands the need of continuous self-learning and self-development; is able to be critical of own and published research results.	SDA3A_K01	Presentation, Participation in a discussion, Involvement in teamwork, Case study, Activity during classes
M_K002	understands the professional and ethical way of realization of research works. is able to work in team and respects the intellectual property rights.	SDA3A_K03	Presentation, Involvement in teamwork, Case study, Activity during classes
Skills: he can			
M_U001	utilizes the knowledge to an analysis of the complex research problems. is able to make conclusions in the basis of results, be critical in their evaluation.	SDA3A_U01	Presentation, Involvement in teamwork, Case study, Activity during classes
M_U002	utilizes the knowledge in the scientific discussions. is able to prepare an analysis of the reserach problem in the form of presentation and to present it on the international forum.	SDA3A_U02, SDA3A_U05	Presentation, Participation in a discussion, Involvement in teamwork, Case study, Activity during classes

Knowledge: he knows and understands			
M_W001	posseses extended knowledge, based on the fundamental thermodynamic concepts. Utilizes the thermodynamics of irreversible processes to an analysis of the real processes and research problems being the scope of PhD thesis.	SDA3A_W01	Presentation, Participation in a discussion, Case study, Activity during classes

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
30	15	0	0	0	0	15	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	understands the need of continuous self-learning and self-development; is able to be critical of own and published research results.	+	-	-	-	-	+	-	-	-	-	-
M_K002	understands the professional and ethical way of realization of research works. is able to work in team and respects the intellectual property rights.	-	-	-	-	-	+	-	-	-	-	-
Skills: he can												
M_U001	utilizes the knowledge to an analysis of the complex research problems. is able to make conclusions in the basis of results, be critical in their evaluation.	+	-	-	-	-	+	-	-	-	-	-
M_U002	utilizes the knowledge in the scientific discussions. is able to prepare an analysis of the reserach problem in the form of presentation and to present it on the international forum.	+	-	-	-	-	+	-	-	-	-	-

Knowledge: he knows and understands												
M_W001	posseses extended knowledge, based on the fundamental thermodynamic concepts. Utilizes the thermodynamics of irreversible processes to an analysis of the real processes and research problems being the scope of PhD thesis.	+	-	-	-	-	+	-	-	-	-	-

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	15 h
Examination or Final test	2 h
Contact hours	5 h
Inne	15 h
Summary student workload	97 h
Module ECTS credits	4 ECTS

Additional information

Module content

Lectures

Fundamental thermodynamic concepts. Thermodynamic Laws.
Reversible and irreversible processes.
Entropy balance in the closed and open systems.
Entropy generation in the heat and mass transfer processes.
Entropy generation minimization.
Linear processes. Onsager Theorem.
Conjugated processes. Curie Symmetry Principle.
Exergy concept and exergy balance in the closed and open systems.
Introduction to the statistical thermodynamics.

Seminar classes

Case studies of particular real systems or processes. They will be as close as possible to the topics being in the scope of PhD thesis. In general, they will base on the published scientific literature and will utilize the extended knowledge of thermodynamic concepts. The aim of studies, their realization and results will be presented together with the critical analysis of the assumptions, methods and conclusions. The discussion will be important element of the classes.

Teaching methods and techniques:

Lectures: The lecture contents is presented in the form of multimedial presentation in connection with the classical board lecture enriched with the display regarding particular problem. The knowledge is also transferred during the discussions moderated by the lecturer.
Seminar classes: Seminars base on the case studies conducted by the students working in the teams. Discussions and critical analyses are very important elements of the classes.

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

Lecture

The participation in the written credit is allowed after getting the positive grade from the seminar and confirmed participation in the lectures (the exception is discussed in other section). There will be three terms of written credit at the end of the classes. The positive grade is regulated by the AGH rules.

Seminar

Confirmed participation in the seminars (the exception is discussed in other section). Positive grade of the preparation and presentation of the assigned topic and also answering the questions and participation in the discussions.

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

Lectures:
– Attendance is mandatory: Yes
– Participation rules in classes: Knowledge and understanding of previously realized material. Participation in the discussions. Asking the questions. Following the rules of PhD School regulations regarding the rights and obligations.
Seminar classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Knowledge and understanding of previously realized material. Presentation of an analysis of particular case study. Working in a team. Participation in the discussions. Asking the questions. Following the rules of PhD School regulations regarding the rights and obligations.

Method of calculating the final grade

Weighted average rating = 0.5· **SR** + 0.5· **CR** ·w
where: **SR** – seminar rate ; **CR** – writtin credit rate;
w – weight, w = 1 first term, w = 0.9 second term, w = 0.8 third term

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

Lecture

One excused absence is allowed. The student is obliged to analyzed and understand realized content by himself/herself.

Seminar

One excused absence is allowed. The student is obliged to prepare an essay on the given problem.

Prerequisites and additional requirements

Knowledge regarding the fundamental thermodynamics, differential and integral calculus.

Recommended literature and teaching resources

1. Szargut J., Termodynamika, PWN, Warszawa 1991
2. Gumiński K., Termodynamika procesów nieodwracalnych, PWN, Warszawa 1986
3. Kondepudi D., Prigogine I., Modern Thermodynamics, Willey, Chichester 1999
4. Bejan A., Advanced engineering thermodynamics, Wiley, Hoboken 2006
5. Bejan A., Entropy generation minimization, CRC, Boca Raton 1996
6. Poniewski M. I in., Termodynamika procesów nierównowagowych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2008

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

E. Fornalik (2009), Magnetic convection of paramagnetic fluid in an enclosure, AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, (monografia)
T. Kura, E. Fornalik-Wajs (2016) Approach to novel design of CO2 based centrifugal compressor, E3S Web of Conferences vol. 10 art. no. 00124,
T. Kura, E. Fornalik-Wajs (2016) Compressor efficiency in the light of blade-fluid thermal interaction, Journal of Physics. Conference Series, vol. 745 art. no. 032065,

Additional information

Listed topics represent only the scope of lecture, forming its basis. They shouldn’t be treated as the titles of particular classes.
Other forms of student’s activity mean a self-studies on the topics analyzed during the lectures.