AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Advanced fluid mechanics

Academic year: 2019/2020 Code: ZSDA-3-0109-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 and strengthens a knowledge regarding advanced fluid mechanics concepts and their applications in the real systems/processes analysis.

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 selflearning and self-development; is able to be critical of own and published research results.	SDA3A_K01	Participation in a discussion, Oral answer, 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	Participation in a discussion, Oral answer, Examination, Activity during classes
M_U002	utilizes the knowledge in the scientific discussions.	SDA3A_U05, SDA3A_U02	Participation in a discussion, Oral answer, Activity during classes
Knowledge: he knows and understands			

M_W001	posseses extended knowledge, based on the fundamental Fluid Dynamics concepts. Utilizes it to an analysis of the real systems/processes and research problems being the scope of PhD thesis.	SDA3A_W01	Participation in a discussion, Oral answer, Examination, 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	30	0	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	understands the need of continuous selflearning and self-development; is able to be critical of own and published research results.	+	-	-	-	-	-	-	-	-	-	-
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.	+	-	-	-	-	-	-	-	-	-	-
Knowledge: he knows and understands												

M_W001	posseses extended knowledge, based on the fundamental Fluid Dynamics concepts. Utilizes it to an analysis of the real systems/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
Examination or Final test	2 h
Contact hours	5 h
Inne	30 h
Summary student workload	97 h
Module ECTS credits	4 ECTS

Additional information

Module content

Lectures

Fundamental concepts and definitions of Fluid Dynamics
Integral and differential forms of the mass, momentum and energy conservation laws
Approximate solutions of Navier-Stokes Equation
Boundary layer and its significance
Dimensional analysis
Compressible Flow
Elements of Computational Fluid Dynamics

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. Discussion is very important element of the classes.

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

The participation in the written exam is allowed after getting the confirmed participation in the lectures (the exception is discussed in other section). There will be three terms of written exams after the classes. The positive grade is regulated by the AGH rules.

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.

Method of calculating the final grade

Weighted average rating =0.7· **E** ·w+0.3· **A**
where: **E** – exam rate, **A** – activity 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:

One excused absence is allowed. The student is obliged to analyzed and understand realized content by himself/herself. If there is a special case it will be considered individually.

Prerequisites and additional requirements

Knowledge regarding the fundamental Fluid Dynamics, differential and integral calculus, basics of Computational Fluid Dynamics.

Recommended literature and teaching resources

1. Jeżowiecka-Kabsch K., Szewczyk H., Mechanika płynów, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2001
2. Duckworth R.A., Mechanika płynów, WNT, Warszawa 1983
3. Prosnak W., Mechanika płynów, PWN, Warszawa 1970
4. Gryboś R., Mechanika płynów, Politechnika Śląska, Gliwice 1991
5. White F.W. Fluid mechanics, Mc Graw Hill, 1985
6. Kundu K.P., Cohen I.M., Fluid mechanics, Elsevier, 2002
7. Elsner J.W., Turbulencja przepływów, PWN, 1987
8. Hinze J.O., Turbulence, Mc Graw-Hill, 1975
9. Cengel Y.A., Cimbala J.M., Fluid Mechanics, Fundamentals and Applications, Mc Graw-Hill, 2006

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

E. Fornalik-Wajs, Thermo-magnetic convection – method of the fluid flow and heat transfer control, Paliwa i energia XXI wieku, Wydawnictwo Naukowe „Akapit”, Kraków, 199–224, 2014.
S. Kenjeres, L. Pyrda, E. Fornalik-Wajs, J.S. Szmyd, Numerical and experimental study of Rayleigh-Bénard-Kelvin convection, Flow, Turbulence and Combustion, 92, 371–393, 2014.
S. Kenjeres, L. Pyrda, W. Wrobel, E. Fornalik-Wajs, J.S. Szmyd, Oscillatory states in thermal convection of a paramagnetic fluid in a cubical enclosure subjected to a magnetic field gradient, Physical Review E; 85, pp. 046312-1–046312-8, 2012.
E. Fornalik, J. S. Szmyd (2007), Experimental investigations of jet flows, Journal of Theoretical and Applied Mechanics, ISSN 1429-2955, Indeks 365238, no. 3, vol. 45, pp. 569-586.
E. Fornalik (2007), Flow patterns generated by a strong magnetic field, Journal of Theoretical and Applied Mechanics, ISSN 1429-2955, Indeks 365238, no. 3, vol. 45, pp. 557-568.
E. Fornalik, J. S. Szmyd (2005), Turbulent heat transfer in a confined jet, Progress in Computational Fluid Dynamics, vol. 5, Nos. 3/4/5, pp.136–143.
K. Nakabe, E. Fornalik, J. F. Eschenbacher, Y. Yamamoto, T. Ohta and K. Suzuki (2001), Interactions of longitudinal vortices generated by twin inclined jets and enhancement of impingement heat transfer, Int. J. Heat and Fluid Flow, vol. 22, pp. 287-292.

Additional information

Listed topics represent only the scope of lecture, forming its basis. They shouldn’t be treated as the titles of particular classes.
Detailed rules for getting the credit of lecture are presented during the first class.

Other forms of student’s activity mean a self-studies on the topics analyzed during the lectures.