Załącznik Nr 5 do Zarz. Nr 33/11/12

(faculty stamp) **Syllabus**

1. Name of the subject: Heat and Mass Transfer				**2. Course code:**
3. Valid in academic year: 2016/2017				
4. Course: MSc (second degree programme)				
5. Type of studies: full time stationery course				
6. Field of study: POWER ENGINEERING				
7. Profile of studies: General academic				
8. Programme: CLEAN FOSSIL AND ALTERNATIVE FUELS ENERGY (KIC INNOENERGY)				
9. Semester: 1				
10. Responsible unit: Institute of Thermal Technology (RIE-6)				
11. Lecturer: prof. Andrzej Nowak				
12. Group of subjects: Core subject				
13. Status: Obligatory				
14. Language of instruction: English				
15. Prerequisites: subject has to be preceded by **Thermodynamics** as well as by **Basic Heat Transfer**				
16. Course objectives: To provide students with advanced phenomena of heat and mass transfer. Practical methods of determination of the heat and mass fluxes in complex technical applications and emphasized.				
17. Learning outcomes:[1]				
	Description of learning outcome	Method of assessments	Type of classes	Reference to learning outcomes
1	Student is able to explain fundamental issues of heat and mass transfer, mechanisms and relationships describing them.	Exam	Lecture	**K2A_W05**, **K2A_W07, K2A_W08, K2A_W09, K2A_U15**
2	Student is able to explain fundamentals of the transient heat conduction and steady-state heat convection with phase change and thermal radiation.	Exam	Lecture	**K2A_W05**, **K2A_W07, K2A_W08, K2A_W09**, **K2A_W17**, **K2A_U15**
3	Student is able to explain analogy between heat transfer and mass transfer as well as dimensionless criteria for convective mass transfer.	Exam	Lecture	**K2A_W05**, **K2A_W08, K2A_W09, K2A_U15**
4	Student is able to formulate simple problems of transient heat conduction.	Colloquium and exam	Problem solving classes	**K2A_W05**, **K2A_W07, K2A_W08, K2A_W09**, **K2A_W17**, **K2A_U15**, **K2A_U18, K2A_U19, K2A_U20**
5	Student is able to formulate convective problems with phase change and radiation.	Colloquium and exam	Problem solving classes	**K2A_W05**, **K2A_W07, K2A_W08, K2A_W09**, **K2A_W17**, **K2A_U15, K2A_U18, K2A_U19, K2A_U20**
6	Student is able to formulate convective transfer problems including absorption.	Colloquium and exam	Problem solving classes	**K2A_W05**, **K2A_W07, K2A_W08, K2A_W09**, **K2A_W17**, **K2A_U15, K2A_U18, K2A_U19, K2A_U20**
18. Type of classes and their duration **Lecture: 30h Problem solving classes/Project/Laboratory: 30h**				

[1] 5-8 learning outcomes should be given

19. Content of the course:

Lecture

Transient heat conduction problems. Heat transfer in fins. Boiling and condensation heat transfer. Fundamentals of thermal radiation. Selected problems of heat exchangers. Fundamentals of mass transfer – analogy between heat and mass transfer, mass diffusion and Fick's law. Mass convection and correlations for mass transfer coefficient. Mass transfer through phase change front. Basic information about absorption.

Lectures are conducted in an interactive way with use of audiovisual tools. During the lecture problem questions/topics are raised, students take part in the discussion and brainstorms, trying to find solution/answers, assess existing solutions as well as develop critical thinking. Students are encouraged to participate in discussions which are moderated by the tutor. Students will be able to assess the dynamic nature of complex systems and change over time. They will be able to apply the tools and concepts of system dynamics and systems thinking in their present lives.

Problem solving classes

Calculation of the heat flux in transient processes. Calculation of heat flux dissipated by the fin. Calculation of the heat transfer coefficients in boiling and condensation processes. Heat exchangers designing and rating. Calculation of the radiative heat fluxes. Calculation of the mass transfer coefficients and analysis of absorption processes.

Additionally three laboratory demonstrations are carried out. These are: analysis of condensation process and determination of the overall heat transfer coefficient, analysis of boiling and determination of heat transfer coefficient, investigations of screens functioning.

20. Examination: yes

21. Basic literature:

1. Y.A. Cenge, *Heat Transfer – Practical Approach*, McGraw-Hill, New York 2003
2. J.H. Lienhard IV, J.H Lienhard V, *A Heat Transfer Textbook*, Phlogiston Press, Cambridge, Massachusetts, USA, 2006 http://web.mit.edu/lienhard.www/ahtt.html

22. Other reading:

1. Scientific journals availabale in university network (Scopus, Science direct etc.)

23. Work load of the student necessary to achieve the learning outcomes

Lp.	Type of classes	Number of contact hours / student work
1	Lectures	30/20
2	Recitations	30/30
3	Lab	/
4	Project	
5	Seminar	
6	Other (participation in consultations associated with project execution)	20/20
	number of hours (subtotal)	80/70

24. Total number of hours: 150

25. Number fo ECTS credits:[2] 5

26. Number of ECTS credit points gained during classes (contact hours):

27. Number of ECTS credits gained during practice oriented classes (labs, projects):

[2] 1 ECTS point – 30 hours workload

26. Remarks:

Teaching tools: **learning by doing, problem solving**

The overall assessment consist of two steps:

1. Check of fulfilling of module LO consequently OLOs criteria.
2. Assessment and grading of the quality of students work and reached LO.

EIT OLOs assessed in the subject :

- Research skills and competencies (EIT OLO 5)
- Intellectual transforming skills and competencies (EIT OLO 6)

The Method of assessments indicated in point 17 includes assessment of learning outcomes and OLOs

Grading:

Grading formula: $FG=PMWF_{lec}*PMG_{lec}+ PMWF_{rec}*PMG_{rec}+ PMWF_{o}*PMG_{o}$
Where:

Where:

- FG-final grade
- $PMWF_{lec}$ – Lecture part weighting factor – 0,6
- PMG_{lec} – Grade of achieved LOs relevant to lecture
- $PMWF_{rec}$ – Recitation part weighting factor – 0,4
- PMG_{rec} – Grade of achieved LOs relevant to recitation
- $PMWF_{o}$ – Other participations part weighting factor – 0,4
- PMG_{o} – Grade of achieved LOs relevant to Other participations.

All LO weighting factors associated with part of the module (PM) equal 1.

Accepted:

…….
(Date and signature of the responsible instructor)

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(*date and signature of teh director of the institute, chair, Director of Foreign Language College/head or director of inter-faculty unit)*