(facultystamp)

COURSE DESCRIPTION

1. Course title:THERMAL PROCESSES IN BIOTECHNOLOGY	**2. Course code:**
3. Validity of course description: 2018/19	
4. Level of studies: bachelor	
5. Mode of studies: full time	
6. Field of study: Biotechnology	
7. Profile of studies: general academic	
8. Programme: BIOTECHNOLOGY IN ENVIRONMENTAL PROTECTION	
9. Semester: 3	
10. Faculty teaching the course: Energy and Environmental Engineering/Institute of Thermal T	
11. Course instructor: **prof. Ryszard Białecki**	
12. Course classification: Common subjects	
13. Course status: mandatory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Physics, Mathematics	
16. Course objectives: exposing students to laws governing heat and mass transfer in living organisms and industrial biotechnology plants	
17. Description of learning outcomes:	

Nr	Learning outcomesdescription	Method of assessment	Teachingmethods	Learning outcomes referencecode
1	Ability of formulating problems of heat and mass transfer	Exam	lecture	K_W04,K_W06,K_W10, K_U07
2	Skills of solving problems of heat and mass transfer	Written tests	Recitations (problem solving classes)	K_W02
3	Knowledge of heat and mass transfer in living organisms	Exams, written tests	Lecture, recitations	K_W02, K_W07, K_U08
4	Critical analysis of obtained results of heat and mass transfer in the context of data uncertainty	Exam	Lecture, recitations	K_U01, K_U11
5	Knowledge of assumptions and simplifications behind the developed models and range of their applications	Exam	Lecture	K_W04,K_W06, K_U08

18. **Teaching modes and hours per semester**
Lecture 30/ Class 30

19. Syllabusdescription:

Lectures:

1. Mass and energy balances: general form of conservation equations, mass sources, internal energy, enthalpy, work
2. Basic notions: heat transfer modes, temperature field, heat flux field
3. Heat conduction: Fourier's Law and energy conservation law, boundary conditions, 1D heat conduction through a flat wall, heat resistance, finite volume method, cylindrical wall
4. Diffusive mass transfer: Fick's law and mass conservation law, phase equilibrium and partition coefficients, diffusive mass transfer though membranes, artificial kidney, administration of medication, diffusion with chemical reaction, chemical reaction kinetics.
5. Heat transfer in human bodies, metabolism, temperature control mechanisms, in vivo heat transfer equation in tissues.
6. Transient heat conduction, lumped analysis, numerical methods, Heissler charts
7. Convective heat transfer: governing equations, similarity theory, flow along a flat wall and pine, pipe bundles, forced convection in closed conduits, natural convection in large volumes
8. Convective mass transfer: analogies with heat transfer
9. Heat radiation: basic notions: blackbody, intensity, radiative properties of surfaces, configuration factor and radiosity, basics of gas radiation

Classes (recitations)

1. Solving practical problems in heat and mass transfer using the knowledge acquired at lectures

20. Examination: YES

21. Primary sources:

R Białecki – lecture notes,

Y. Cengel A. Ghajar Heat and Mass Transfer: Fundamentals and Applications, Mc Graw Hill, 5th edition 2015,

A. K. Datta Biological and Bioenvironmental Heat and Mass Transfer, CRC Press, 2002

22. Secondary sources:

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/30
2	Classes	30/30
3	Laboratory	
4	Project	
5	BA/ MA Seminar	
6	Other	15/15
	Total number of hours	75/75

24. Total hours: 150

25. Numberof ECTScredits: 5

26. Number of ECTS credits allocated for contact hours: 2.5

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 0

26. Comments:

Approved:

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(date, Instructor's signature)

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(date, the Director of the Faculty Unit signature)