Building physics - BMEEOEMMS51

I. Subject Specification

1. Basic Data

1.1 Title

Building Physics

1.2 Code

BMEEOEMMS51

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2

1.5 Evaluation

Midterm grade

1.6 Credits

3

1.7 Coordinator

name	Dr. Nagy Balázs
academic rank	Assistant professor
email	nagy.balazs@emk.bme.hu

1.8 Department

Department of Construction Materials and Technologies

1.9 Website

https://epito.bme.hu/BMEEOEMMS51
https://fiek2.mywire.org/course/view.php?id=1977

1.10 Language of instruction

hungarian

1.11 Curriculum requirements

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1.12 Prerequisites

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to provide the student with the principles of modern building physics, the theory of heat conduction, heat flow, heat radiation, heat transport processes, technical alternatives for heat loss reduction in buildings and structures, the role of outdoor and indoor environmental boundary conditions for building physics calculations and how to determine them, analytical thermal calculations of building structures, the theory and practical application of unsteady, transient, non-linear and multi-dimensional thermal processes, coupled heat, air and moisture transport simulations and basic knowledge of urban building physics.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. know the commonly used concepts of modern building physics,
2. knowledge of unsteady, transient, non-linear, complex and multidimensional heat and mass transfer processes,
3. knowledge of standardized and detailed calculation procedures for building structures in terms of thermal and moisture engineering,
4. knowledge of the specific building physics of ground-contact structures,
5. knowledge of the outdoor and indoor environmental boundary conditions essential for building physics calculations and numerical simulations,
6. knowledge of the principles of coupled heat, air, and moisture transport simulations,
7. knowledge of the commonly used concepts of urban building physics and building aerodynamics,
8. knowledge of laboratory and field-testing procedures for building physics and building energy.

B. Skills

1. carry out standardized and detailed thermal calculations of building structures,
2. be able to include the boundary conditions of building physics calculations and numerical simulations, depending on the indoor and outdoor environment,
3. able to perform coupled heat, air, and moisture transport simulations,
4. ability to perform building physics diagnostic tests, use infrared thermography,
5. able to identify heat loss reduction alternatives for buildings and structures,
6. the ability to solve complex and computationally demanding problems, based on knowledge of building physics,
7. express ideas in an organized way, both orally and in writing.

C. Attitudes

1. collaborate with the lecturer and fellow students to develop their knowledge,

2. continuously expand their knowledge by acquiring new knowledge,
3. is open to the use of information technology tools,
4. strive to learn and routinely use the tools needed to solve problems in building physics,
5. strive for accurate and error-free problem solving,
6. to apply the principles of energy efficiency and environmental awareness in solving building physics problems.

D. Autonomy and Responsibility

1. independently think through building physics problems and problems and solve them based on given resources,
2. independently solve a homework assignment,
3. is open to well-founded critical comments,
4. collaborate with fellow students as part of a team in certain situations,
5. uses a systematic thinking approach.

2.3 Methods

Lectures, computational and software exercises, written and oral communication, IT tools and techniques, group work, and work organization techniques.

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Principles of heat transport processes: heat conduction, heat flow, heat radiation I.
2.	Principles of heat transport processes: heat conduction, heat flow, heat radiation II.
3.	History of the development of standards and legislation on building physics and energy performance
4.	Detailed thermal calculations of building structures - MSZ EN ISO standard calculations I.
5.	Detailed thermal calculations of building structures - MSZ EN ISO standard calculations II.
6.	Basics of transient thermal calculations. Summary.
7.	Overview.
8.	Coupled heat, air and moisture transport simulations for structural engineers I.
9.	Coupled heat, air and moisture transport simulations for structural engineers II.
10.	Building physics laboratory and on-site diagnostic studies.
11.	Building physics development of traditional and modern thermal insulation materials and building systems
12.	Building and urban scale building physics simulations and fundamentals of building aerodynamics. Building physics from BIM principles. Air tightness of buildings.
13.	Building physics case studies from the Hungarian

	construction industry, building defects and their prevention
14.	Summary, overview.

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

- Course materials uploaded to edu.epito.bme.hu
- Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt (2011): Fundamentals of Heat and Mass Transfer, John Wiley & Sons , 7th ed., p. 1076
- Hugo Hens (2012): Building Physics: Heat, Air and Moisture, Fundamentals and Engineering Methods with Examples and Exercises, Ernst & Sohn, 2nd ed., p. 324
- Hugo Hens (2010): Applied Building Physics: Boundary Conditions, Building Performance and Material Properties, Ernst & Sohn, p. 319
- João M.P.Q. Delgado, Eva Barreira, Nuno M.M. Ramos, Vasco Peixoto de Freitas (2013): Hygrothermal Numerical Simulation Tools Applied to Building Physics, Springer, p. 72
- MSZ EN ISO standards

2.6 Other information

Attendance is compulsory for at least 50% of the lectures.

2.7 Consultation

As indicated on the department's website, or by prior arrangement by e-mail or MS Teams: nagy.balazs@emk.bme.hu

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes in 2.2 is based on a test, a homework assignment and active participation in lectures (partial assessment).

3.2 Assessment methods

Evaluation form	**Abbreviation**	**Assessed learning outcomes**
test	ZH	A.1-A.4; B.1
homework assignment	HF	A.5-A.7; B.2-B.7
active participation	A	A.1-A.8; C.1-C.6; D.1-D.5

The dates of deadlines of assignments/homework can be found in the detailed course schedule on the subject's website.

3.3 Evaluation system

Abbreviation	**Score**
ZH	40%
HF	50%
A	10%
Sum	**100%**

3.4 Requirements and validity of signature

No signature can be obtained on the subject.

3.5 Grading system

Grade	**Points (P)**
excellent (5)	90% ≤ P
good (4)	75% ≤ P < 90%
satisfactory (3)	60% ≤ P < 75%
passed (2)	50% ≤ P < 60%
failed (1)	50% < P

3.6 Retake and repeat

- By its nature, active participation cannot be replaced, corrected or otherwise substituted,
- The final examination may be replaced or corrected once during the repeat period, free of charge. The student's preference will be considered in the case of a correction.
- The homework may be submitted in the repeat period.

3.7 Estimated workload

Activity	**Hours/semester**
participation in lectures	14×2=28
preparation for lectures	14
preparation for test	24
homework assignment	24
Sum	**90**

3.8 Effective date

1 September 2022

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Inactive courses