PRACTICAL INFORMATION

FEE

The fee includes the tuition fee, course notes, soft drinks, coffee and sandwiches. Payment occurs after reception of the invoice. All invoices are due in thirty days. All fees are exempt from VAT.

Module 0: Basic concepts	€ 570
Module 1: Heat production and transport	€ 675
Module 2: Thermal cycles	€ 900
Module 3: Electric grids and drives	€ 825
Module 4: Energy management and policy	€ 800
All modules	**€ 3.400**

REDUCTION

- When a participant of a company subscribes for the complete course, a reduction of 20% is given to all additional subscriptions from the same company, even on single lessons. Invoicing is then done by one company invoice.
- AIG and VBIG members receive a reduction of 10% on the prices mentioned in the table.
- Special prices for Ghent University staff and members of Ghent University Association.
- Reductions can't be combined.

CANCELLATION POLICY

When cancelling up to 10 days before the start of the course or module 25% of the participation fee will be charged. When cancelling less than 10 days before the start of the module, the full fee is due.

TRAINING CHEQUES

Ghent University accepts payments by KMO-portefeuille (www.kmo-portefeuille.be; authorisation ID: DV.0103194).

TIME AND LOCATION

- The lessons are given from **16h00 till 21h15** with a sandwich break and a coffee break. All lessons are given on Tuesday expect the second lesson of module 1. This lesson is scheduled on Wednesday.
- Location: **building 904, Technologiepark, Zwijnaarde.**
- Dates may change due to unforeseen reasons.

LANGUAGE

English is used in all presentations, exercises and documentation, so ready knowledge of English is necessary.

REFERENCE BOOKS

- "Fundamentals of Engineering Thermodynamics: SI version" by M.J. Moran and H. Shapiro (€ 74,95 including VAT), mandatory for the participants of modules 0, 1 and 2.
- "Heat Exchangers. Selection, Rating and Thermal Design" by S. Kakaç and H. Liu (€ 116,96 including VAT), mandatory for the participants of modules 0, 1 and 2.
- Reference books are billed directly by the bookshop.

MORE INFORMATION AND SUBSCRIPTION

www.ugain.ugent.be/EEI

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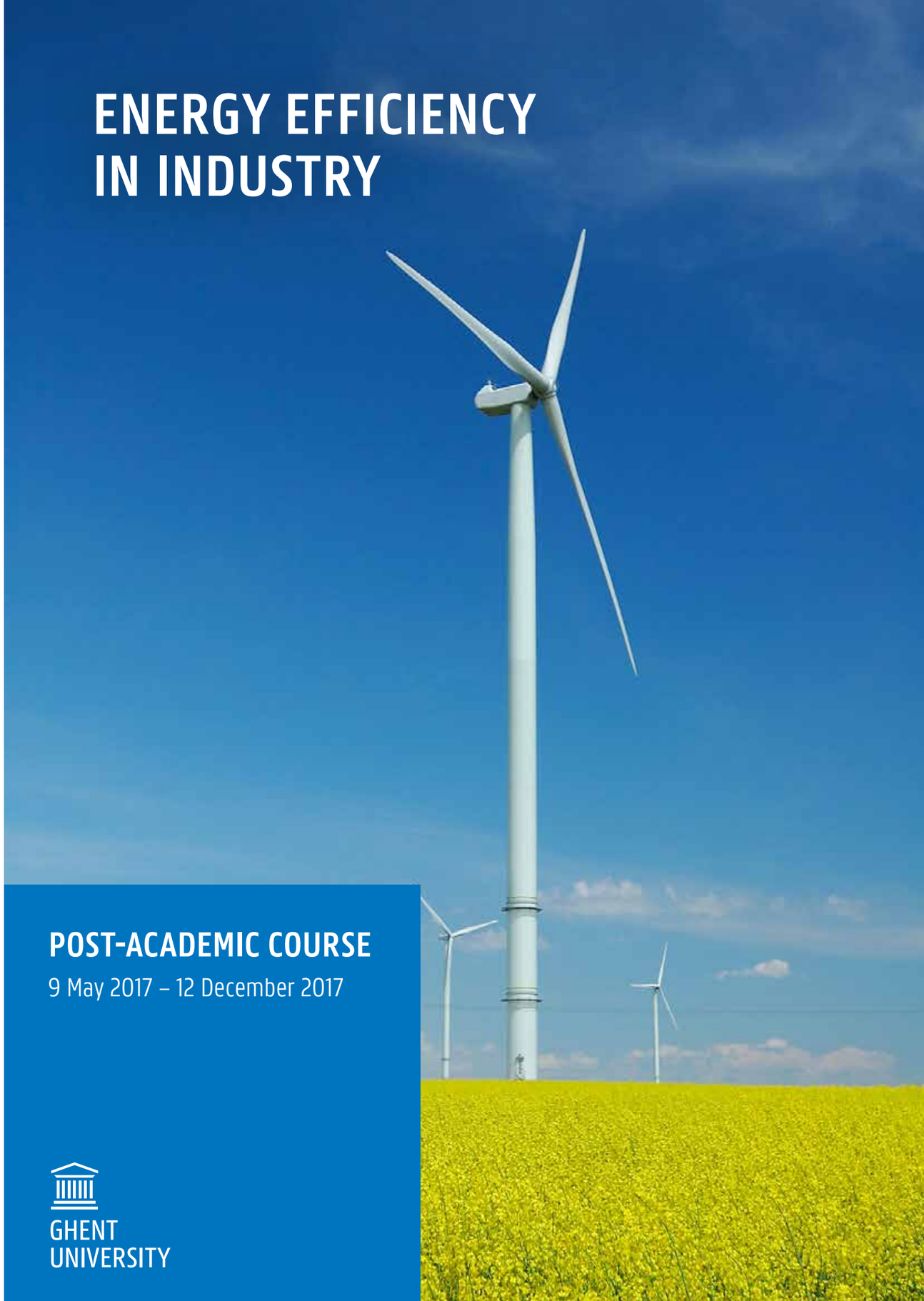
GHENT UNIVERSITY

FACULTY OF BIOSCIENCE ENGINEERING

FACULTY OF ENGINEERING AND ARCHITECTURE

ENERGY EFFICIENCY IN INDUSTRY



POST-ACADEMIC COURSE

9 May 2017 – 12 December 2017

GHENT UNIVERSITY

INTRODUCTION

The 2015 United Nations Climate Change Conference in Paris resulted in the signing of the Paris Agreement on 22 April 2016 in New York by 174 nations on this planet. In the adopted version of the Paris Agreement the parties will pursue efforts to limit the temperature increase to 1.5°C. The 1.5°C goal will require zero emissions sometime between 2030 and 2050, according to some scientists.

Industrial efforts to reduce energy demand, allowing the transition to a carbon free society are thus needed. Energy efficiency is the key for allowing the introduction of renewable energy on a global scale.

Reaching energy efficiency requires a complex mix of technological measures. Care must be taken that several measures do not obstruct each other and an overall view has to be kept.

This course aims at providing the participants this overall view. The course treats a wide scope of topics : from heat to power, control and the economical and legislative context of energy. New energy technologies emerging in the market are treated and the link with the EU policies has been added. Each topic starts with the scientific fundamentals and ends with industrial examples. After attending the course, participants will be able to apply the gained knowledge in energy projects in their company.

POST-ACADEMIC COURSE CERTIFICATE

This programme is part of Ghent University's post-academic courses. To receive a certificate, one should attend at least 3 of the 4 modules (module 0 not included) and succeed for the final exam.

WHO SHOULD ATTEND?

This advanced course is intended for all energy intensive industries and will cover the possibilities for energy recovery and efficient energy use. Everybody involved in energy related projects or energy management in an industrial context will find attractive topics in the course. Not only the process engineer or energy manager, but also auditors and consultants will take benefit of this course. Basic engineering skills are required to enrol.

SCIENTIFIC COORDINATION

Prof. Michel De Paepe, Department of Flow, Heat and Combustion Mechanics, Ghent University

TEACHERS

- An Beazar, Enprove
- Tom Capiau, Egemin
- Mieke Dams, Milora
- Morten Deding, Johnson Controls
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0. BASIC CONCEPTS

Module 0 aims at revising and extending basic concepts of thermodynamics, combustion science, heat exchangers and electrical energy systems. This module starts with the formulation of the First and Second Law of Thermodynamics, and develops them to useful methods to assess energy quality. The laws are thereupon applied to combustion processes, thermal energy systems and heat exchangers. There is also special attention to the transport and use of electrical energy.

Concepts introduced in module 0 will be used in the other modules.

- The laws of thermodynamics
- Combustion chemistry & energy conservation in combustion
- Energy conversion cycles
- Heat exchangers: types, use and sizing
- Refrigeration cycles
- Electrical drives and electrical power grids

Teachers: M. De Paepe, B. Merci and L. Vandevelde
Date: 9, 16 and 23 May 2017

1. HEAT PRODUCTION AND TRANSPORT

In module 1, heat as a form of energy is treated. Heat exchangers, as used in process industry for air, water and steam (steam boilers), will be discussed. Transport of heat is as important in lots of processes (water and steam network, thermal oil).

Attention is paid to new trends in combustion technology for fossil and bio fuels. Recent advances in burner technology will be dealt with in relation to the emission reductions.

Finally this module ends with pinch technology for heat exchanger network optimization. The participants will have the opportunity to apply their acquired knowledge in a hands-on exercise.

Heat exchangers and heat transport
- Recovery heat exchangers
- Steam/heat boilers and heaters
- Steam networks
- Case

Recent developments in combustion technology
- Solid combustion
- NOx emission reduction
- New combustion technologies
- Biomass

Pinch technology: theory and exercise

Teachers: M. De Paepe, H. Fastenaekels, F. Koninckx, B. Merci, M. Van Belleghem and D. Van Paemel
Date: 30 May, 7 and 13 June 2017

2. THERMAL CYCLES

In this module performance of thermal cycles is discussed. A first topic is cooling technology on an industrial scale. A distinction is made between low temperature cooling (< 0°C) and high temperature cooling (>0°C), the latter not always needing chillers.

A second topic is cogeneration (Combined Heat and Power, CHP) and trigeneration. New and old possibilities for energy recovery as Organic Rankine Cycles (ORC) are considered.

At the last day of this module industrial heat pumps and their application are discussed.

Every lesson day ends with case studies and hands-on exercises presented by lecturers from industry. The purpose is to demonstrate the benefits and difficulties of some technologies and how some projects were realized.

Industrial cooling
- Compressor chillers and ice water production
- Cooling water and cooling towers
- Case: Renovation of an 9 MW cooling tower
- Case: Hot water smart grid

Heat and Power
- Combined-Heat-and-Power
- Absorption chilling
- Case: Saflex
- Case: WKK: engines and turbines

Organic Rankine Cycle: theory, case and exercise

Heat upgrading
- Theory, in practice & case
- Case: Heat transport and networks

Teachers: M. Deding, M. De Paepe, D. Goovaerts, D. Hamerlinck, S. Lecompte, S. Lemmens, J. Roef, W. Van de Walle, A. Van Hemelrijk, S. van Heule, B. Vanslambrouck and I. Verhaert
Date: 19 and 26 September, 3 and 10 October 2017

3. ELECTRIC GRIDS AND DRIVES

Module 3 gives an overview of electrical and pneumatic drives in the energy performance of a company. First the construction, stability and control of power grids are described in detail, with special attention to decentralized production grids. Secondly electrical drives are treated, discussing the recent evolution in engine technologies, and their potential. Attention is also paid to the choice of the correct drive in order to match the load (pumps, compressors, start/stop behaviour). The relation between energy use and control of continuous processes is lectured later. Next to the theoretical background, attention is paid to industrial aspects by presenting cases of daily industrial practice.

- Electric grids
  - Distributed generation, smart grids & peakshaving: theory and cases
  - Power Quality: theory and cases
- Electric drives
- Pumps
- Pneumatics

Teachers: A. Beazar, S. Dereyne, J. Desmet, H. Hoebeke, M. Meeuws, K. Stockman, P. Van Dorst and B. Zwaenepoel
Date: 17 and 24 October, 7 and 14 November 2017

4. ENERGY MANAGEMENT AND POLICY

The last module handles energy management and energy economy. Experience shows that projects which are often technically promising, fail at the management level. The first lectures are dedicated to control strategies in processes. The second day goes into energy management systems and monitoring. In the second part of the module project management and financial aspects of energy management are discussed. The setting up of an energy accountancy system and data analysis is treated. The last part of the module treats the policy and legislation framework of energy on an international scale. The impact of policy instruments on cost effectiveness and project feasibility is dealt with. Again, practical cases and industrial experience are highlighted by case presentations.
- Control
- Energy management and integration
- Financial project appraisal
- Climate change and legal framework

Teachers: A. Beazar, T. Capiau, M. Dams, R. De Keyser, A. Polfliet, J. Vanden Eynde, A. Verbruggen, S. Vergote and J. Verhasselt
Date: 21 and 28 November, 5 and 12 December 2017

MORE INFORMATION AND SUBSCRIPTION

www.ugain.ugent.be/EEI