



# HEAT AND POWER TECHNOLOGY

COMPUTERIZED EDUCATIONAL PLATFORM  
COMPEDUHPT

Newsletter 18

May, 2009

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<http://www.compedu.net/>

The next international reference group meeting will take place in Orlando, ASME TURBO EXPO  
Grand 2, Orlando World Marriott Center  
Thursday, June 11, 13.00-14.15

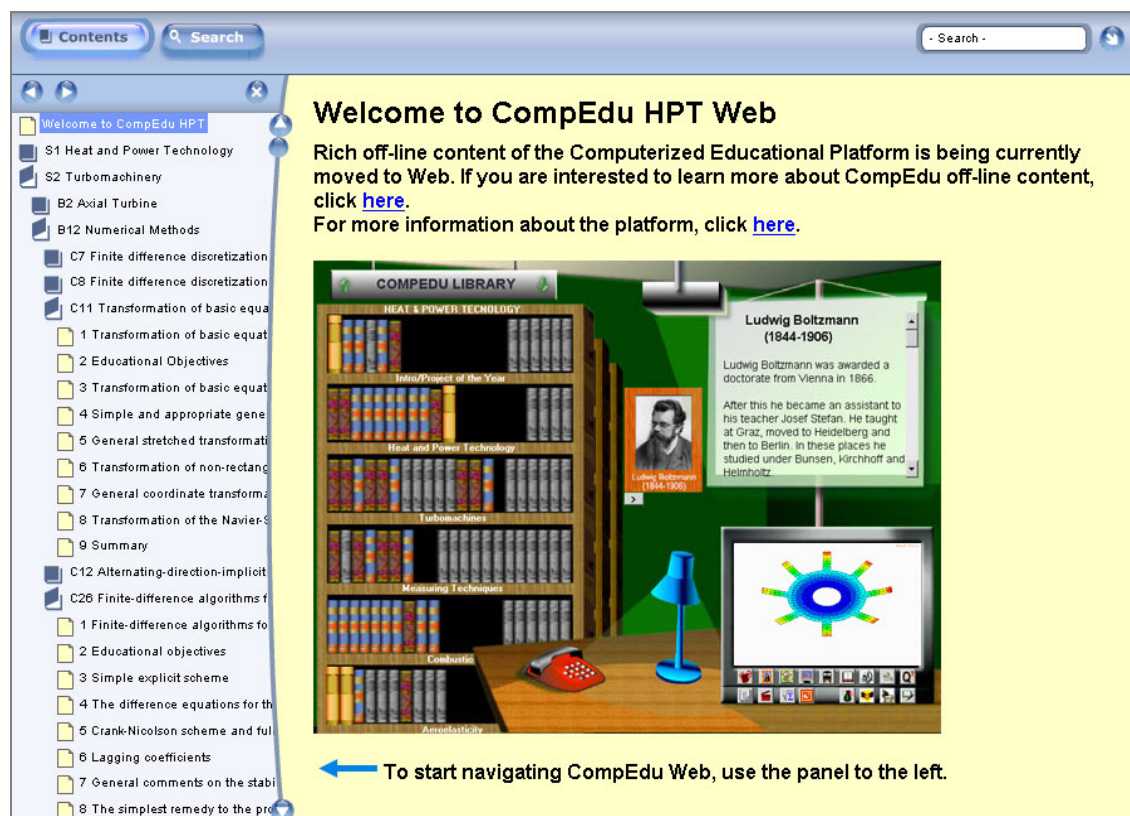
**Welcome to the May 2009 edition of CompEduHPT newsletter!**

*This Newsletter is distributed to the world-wide “family and friends” of the CompEduHPT-platform.*

*CompEduHPT is an interactive multimedia-learning platform, on the subject of Heat and Power Technology. It has been developed at the Division of Heat and Power Technology in the Royal Institute of Technology (KTH) Sweden, in collaboration with several partner universities and industrial organizations worldwide. More information can be found at <http://www.compedu.net>.*

If you prefer to not receive this Newsletter [Click Here](#)

**CompEdu** is available online (Figure 1) for personal computers running in any operational system supporting common web-browsers, as well as mobile devices, such as PDAs. At the moment, 35 e-books (Appendix 1) with 95 chapters are available in the web-based version.



**Fig. 1: WebCompEdu interface**

## New highlights of CompEdu since Newsletter 17:

### ➤ Measuring Techniques

10 new chapters have been published in Shelf 3. There are 2 new chapters in the 1<sup>st</sup> book “Introduction to Measuring Techniques”. Book 3, “Pressure measurements”, has been completed with 1 introductory chapter. In book 4, “Measurement of Flow Velocity”, 3 new chapters have been published. 2 new chapters are found in book 5, “Flow Measurements”, and 2 new chapters are found in book 7, “Temperature Measurements”. These chapters are all developed by Prof. Torsten Fransson.

### ➤ Numerical Methods in Energy Technology

The chapters on this topic are now found in Shelf 7. Currently, there are 3 chapters published in the 1<sup>st</sup> book “Basics of Numerical Methods in Continuum Mechanics” and 6 chapters in the 2<sup>nd</sup> book “Advanced Modern Numerical Methods in Continuum Mechanics”. 16 new chapters will soon be published in this Shelf, where all chapters except one of them will be introduced in the book “Advanced Modern Numerical Methods in Continuum Mechanics”. These chapters are all developed by Prof. Ivan Kazachkov. The simulations are transformed from CompEdu platform to the WebCompEdu format by his team at the NTUU “KPI” in Kyiv, Ukraine. Presently there are about ten simulations under testing at EGI and the comments are collected for further improvement. A few others are prepared by programmer to send in to EGI/KTH. And the new chapters have been recently developed by the new bell-type combustion systems and stoves too. They are now prepared for introduction into CompEdu after finalization with account of all comments from EGI.

The ideas for 3 new chapters by molecular thermodynamics and liophobic materials are under development. The materials collected and preliminary drafts made. Students at NTUU “KPI” are doing some improvement for the chapters 3 and 4 of the 1<sup>st</sup> book “Basics of Numerical Methods in Continuum Mechanics”.

The CompEdu platform is introduced at the educational process at the NTUU “KPI” and a few other Ukrainian universities under leadership of Ivan Kazachkov who is doing presentations every year at the conferences in Kyiv by multimedia education using the CompEdu.

### ➤ Other Heat and Power Cycles

#### **Organic Rankine Cycle (Author: Jaakko Larjola, University of Lappeenranta, Finland)**

The organic Rankine cycle uses an organic fluid as a working medium instead of water that is typically used in the conventional Rankine cycle.

Advantages with this cycle are the possibility to use relatively low temperature heat sources to get electricity and it can be used for small-scale power generation.

### ➤ Heat and Power Technology

#### **Introduction to MSW Incineration (Author: Seksan Udomsri, KTH)**

This chapter presents the basic concept of Municipal Solid Waste (MSW) incineration. Included are incineration technologies, an overview of process technologies, energy recovery and pollution control systems.

Waste incineration, including energy recovery in a waste-to-energy (WTE) system, is a very popular and attractive method for handling MSW in Europe and Japan.

## ➤ Turbomachinery

### **Turbomachinery AXIsymmetric (Author: Dario Bruna, NASA)**

This chapter presents a complete methodology for the design of axial flow turbomachinery: it includes flow-path and grid generators, a solver and a post-processor. This chapter presents a complete up-to-date turbomachinery design system, which combined with the design software T-AXI (a 2-D axisymmetric through-flow solver), deals with the design and upgrade of turbomachinery componets (e.g. single stage transonic compressor, multistage aeronautical and industrial LP turbines, etc).

## ➤ Aeroelasticity

### **Introduction to Static Aeroelasticity (Author: Nenad Glodic, KTH)**

This chapter gives an overview of the main static aeroelastic phenomena and explains the underlying physics. Static aeroelasticity covers the interaction between aerodynamics and solid mechanics in Collar's triangle of forces. By definition, time is not present as an independent variable. This implies that no vibrations are involved, *i.e.* inertial forces are neglected.

## ➤ Aeroelastic Coupling Methods

### **Introduction to Industry Practices for Forced Response Prediction in Bladed Disks (Author: Maria Mayorca, KTH)**

Sources of excitation on turbine components can lead to vibration problems that can put at risk the integrity of the machine. This chapter presents industry current practices and developing strategies in order to predict force response levels in bladed disks and estimate if the machine is under stress limits and is safe to operate. The chapter is oriented to aero engine design, but the process can be extrapolated to industrial gas turbines for electricity generation.

## ➤ Unsteady Aerodynamics

### **Introduction to Unsteady Aerodynamics (Author: Hakim Ferria, KTH)**

Unsteadiness phenomenon is obviously characterized by a time dependence of velocity components and thermodynamic variables. Actually, this time-dependency expresses the consequences of the unsteadiness rather the causes. The chapter presents first what the unsteadiness is from a general point of view but oriented to turbomachines then keys are presented on how the unsteadiness toward turbomachines is approached. Finally numerical aspects are introduced.

## ➤ Different types of Gas Turbine materials

### **Introduction to Different types of Gas Turbine materials**

**(Author: Sebastian Reichardt, KTH)**

Since early days of development there has been substantial efforts made to increase the temperature and pressure inside gas turbine engines. This is also a main factor behind the invention of super alloys. Temperature increase for gas turbine engines has been achieved through a combination of improved materials, elaborate cooling designs and not at least thermal barrier coatings. The purpose of this chapter is to define and describe the basis of the materials important for Gas turbine design. There is also an intention to inform how this development took new interesting ways such as the introduction of TBC.

## ➤ General characteristics of fuel cells

### **Introduction to General characteristics of fuel cells**

**(Author: Sebastian Reichardt, KTH)**

Fuel cells are direct energy conversion devices, enabling the stored chemical energy of fuels to be transformed into electrical energy. Thus circumventing the Carnot rule all types of fuel cells converts the chemical energy of liquid or gaseous fuels, such as hydrogen, hydrazine, ammonia, hydrocarbons combined with suitable oxidants; such as oxygen, air, hydrogen peroxide, or even chlorine. The purpose of this chapter is to introduce and explain: Different types of fuel cells and the electrochemical laws governing them. To introduce a live case scenario and enable the reader with some basic calculation skills in the field.

## ➤ Novel cycles of Heat and Power Generations

### **Introduction to Novel cycles of Heat and Power Generations**

**(Author: Nur Farizan Munajat, KTH)**

As the thermal power technology continues to expand, there will be a need to develop Novel cycles that can increase the efficiencies and flexibilities of energy production instead using a basic heat power cycles. The novel and innovative in power cycle development is the possible ways to improve performance of thermal power technology. In future, the pattern of energy systems will consist of a mixture of central and decentral plants. Novel cycles have been proposed to enhance efficiency of energy production.

## ➤ Solar Energy

### **Introduction to Novel Solar Energy and Solar Thermal Collectors (Author: Maria Fenanda Gomez, KTH)**

As solar energy continues to increase its importance worldwide as a sustainable energy resource, 2 chapters dealing with the basics about solar energy have been developed. The first chapter gives an overview of solar energy fundamentals and its applications while the second chapter deals more in detail with solar thermal energy including types of solar collectors, applications, advantages and limitations, and other relevant aspects.

## ➤ Military Technology

### **Laser Technology**

**(Author: Stefan Silfverskiöld, Swedish National Defence College)**

2 chapters dealing with laser technology for military applications have been included recently. The chapters explain the basics of laser technology and discuss the applications in the military area.

### **Cluster warheads**

**(Author: Jesper Bennhult, Swedish National Defence College)**

This chapter covers the structure, function and performance of cluster warheads.

## ➤ Mathematical Terminology

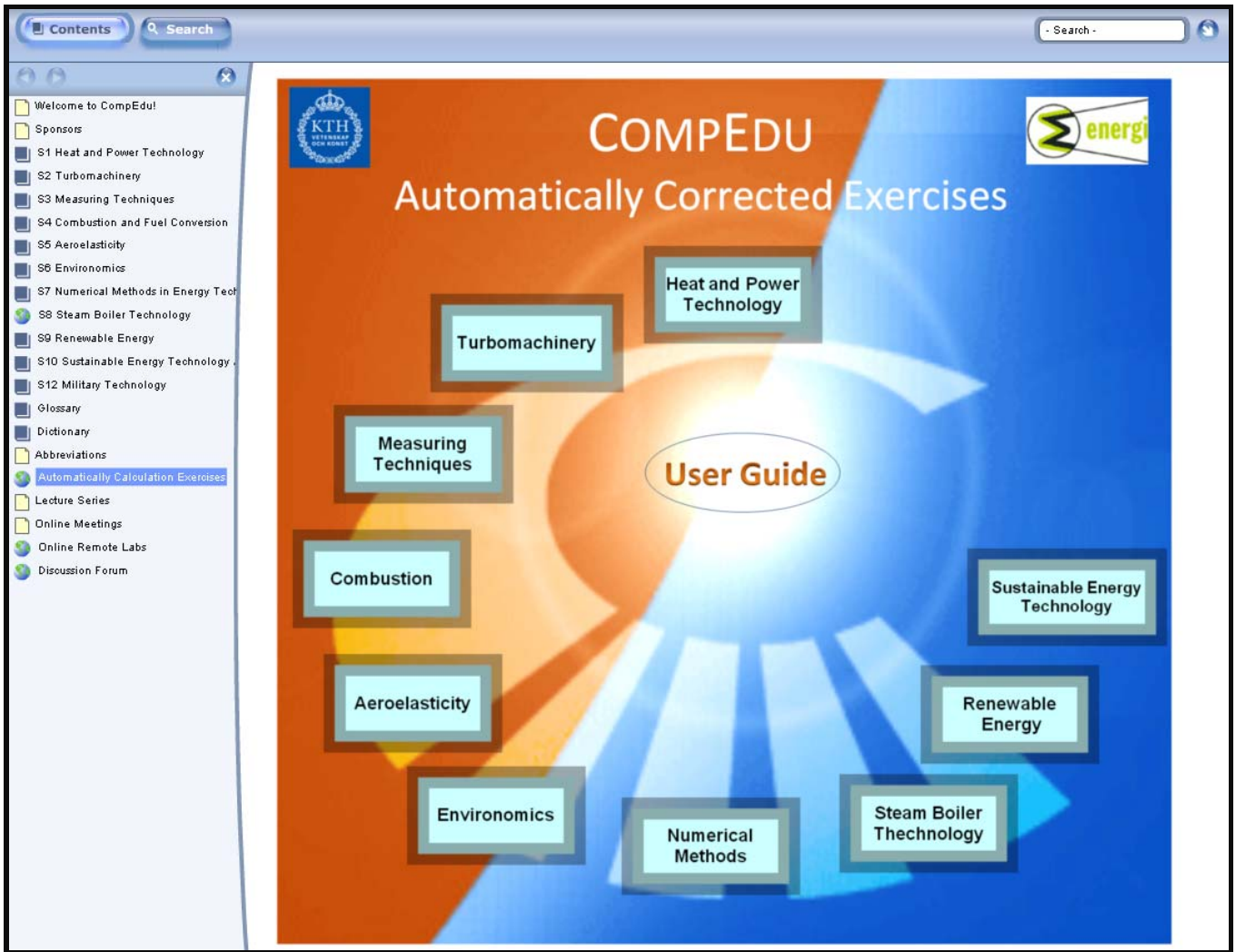
**(Author: Babak Rezapoor, KTH)**

A part under the name "Math Terminology" is developed to help reading the math equations and facilitate the correct way of expressing the math terminology. There is also a recorded voice of a native English speaker for each term so the user can hear the term's pronunciation by clicking the audio bottom.

## ➤ New Home page for Automatically Calculation Corrected Exercises (ACCE)

**(Author: Matteo Marcucci, KTH)**

The new Home page for Automatically Calculation Corrected Exercises is available on CompEdu web page (Figure 2). The "Exercises Home" is located in the first page of CompEdu under the shelves on the left side. It is composed by 10 buttons placed in a circle where each of these opens a new window with the list of exercises. Under the User Guide button which is located in the center of the circle is found a short explanation about how to use the Automatically Corrected Calculation Exercises.



**Figure 2: Home page for Automatically Calculation Corrected Exercises (ACCE)**

Several new “Automatically Calculation Corrected Exercises” have been introduced in which the student can “buy” hints and the Solution Procedure in the case he/she is not able to solve the problem. If the student still cannot solve the problem after using all hints, it is possible to “buy” the Result. Each student insert individual data and the program create individual results. With this excersise procedure they solve the problem with their own data and countercheck with the result. This latter way is a very effective tool for students to self-learn while still receiving interactive advice from the teachers, if they do not know how to fully solve the problem.

Furthermore there are also other types of self-assessment exercises in CompEdu. They are presented in: “classical” way where the problem is specified and the solution is given as a pdf-file and as “filmed” exercises in which the teacher solves the problem in the same way as would be done on the black board in a lecture and also as quizzes.

### ➤ **A new button for your Feedback**

The possibility to contact the development team to suggest changes or improvements has been added recently to the platform in the form of a feedback button. This button provides automatically to the developers the page from where the comment is originating. All feedback sent to us is stored in a database for further consideration.

### ➤ **The CompEdu Template**

The CompEdu Template has been up-dated with some new functions:

- The "Where am I" function, where the hierarchy of the chapter is shown. This function helps the reader to easily find out a fast glance of the part of the chapter he/she studies, as well as a comprehensive perspective how every main part of the chapter relates with each other. In each hierarchy all related pop-ups of that part is shown.
- Information on how to handle links to external websites has been added. Sometimes you find e.g. very instructive and interesting multimedia such as short movies from third party websites regarding the topic that you are preparing your chapter on. In this case you can use them in CompEdu chapters provided that you check the Copyright for the media. However, it has to be stated in the CompEdu chapter that the CompEdu developers and platform are not responsible for the content of the external internet sites suggested, and that there is also no guarantee that the site is still valid.

### ➤ **Some hints for effective use of CompEdu**

1. Authors and developers can directly modify the content of their chapter by using any web page program editor. One simply needs to locate the page and right click on it to search its location (see Fig. 3 arrow A). With this information, the author/developer can open the page and edit the information contained in the page. This can be done for a local version available to the author or the modified page can also be send to the CompEdu development team for update in the main web-based version. Contact person is Marianne Salomon Popa <[marianne@energy.kth.se](mailto:marianne@energy.kth.se)>.

2. There are simple reference mechanisms to the content from other documents, for example from PowerPoint presentations. Each picture, video or simulation is a separate linkable file published online. The paths to the documents can be found/copied using default web-browser Property menus. This enables reusing the materials for illustration in any other context by copy/paste or hyperlinks to WebCompEdu pages. Detailed descriptions about linking the content can be found in WebCompEdu, as shown in Fig. 3, arrow A.

3. The browser Favorites menu can be used to keep bookmarks to WebCompEdu pages. Detailed descriptions about putting bookmarks can be found in WebCompEdu, as shown in Fig. 3, arrow B.

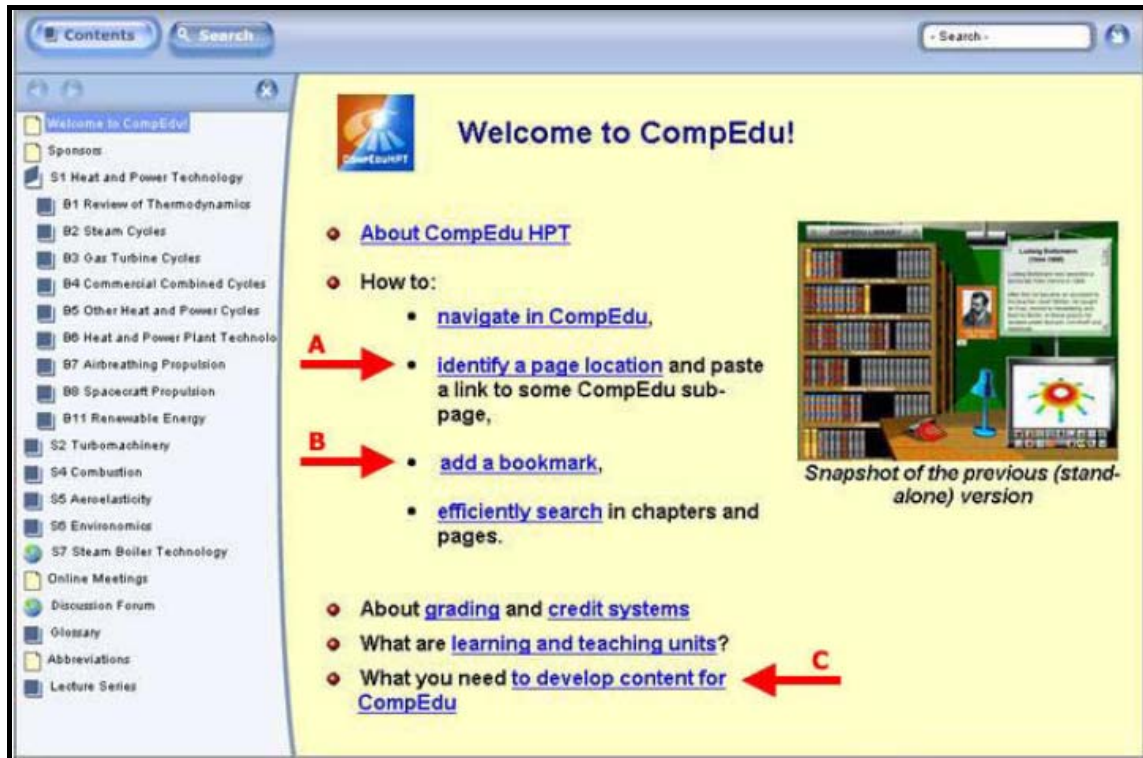


Figure 3: WebCompEdu Navigation menu

## Acknowledgements

The CompEdu team is very grateful to all the teachers and researchers who have participated in the development. Some of these people are mentioned in this Newsletter, and many other are continuously contributing to the development of CompEdu HPT. The CompEdu team would also like to thank you all for your efforts.

***The next international reference group meeting will take place in Orlando  
ASME TURBO EXPO  
Grand 2, Orlando World Marriott Center  
Thursday, June 11, 13.00-14.15***

Best Regards  
Torsten

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## **Appendix 1**

### **The e-books available in the web-based version**

#### Shelf 1: Heat and Power Technology

- B1: Introduction
- B2: Steam Cycles
- B3: Gas Turbine Cycles
- B4: Combined Cycles
- B5: Other Heat and Power Cycles
- B6: Heat and Power Plant Technology
- B7: Airbreathing Propulsion
- B8: Spacecraft Propulsion
- B9: Virtual HPT Study Visits
- B10: Nuclear Power

#### Shelf 2: Turbomachinery

- B2: Axial Turbine
- B3: Axial Compressor
- B4: Radial Compressor
- B7: Hydraulic Turbines

#### Shelf 3: Measuring Techniques

- B3: Pressure Measurements
- B4: Measurements of Flow Velocity
- B5: Flow Measurements

#### Shelf 4: Combustion & Fuel Conversion

- B1: Combustion Basics
- B3: Laminar Flames
- B5: Solids Combustion and Pollutant Emissions
- B6: Combustion Devices
- B9: Fuels and Energy Carriers
- B10: Biomass Gasification

#### Shelf 5: Aeroelasticity

- B1: Introduction to Aeroelasticity
- B2: Basic Aeroelastic System
- B3: Structural Models
- B7: Experimental Techniques

#### Shelf 6: Environomics

- B1: Energy and Environment
- B2: Energy Economics

#### Shelf 7: Numerical Methods in Energy Technology

- B1: Basics of Numerical Methods in Continuum Mechanics
- B2: Advanced Modern Numerical methods in Continuum mechanics

#### Shelf 8: Steam Boiler Technology

#### Shelf 9: Renewable Energy and Sustainable Technology

- B1: Basics about Sustainable Technology
- B2: Energy Engineering
- B3: Renewable Energy
- B4: Wind Energy
- B5: Hydropower

B6: Bioenergy

B7: Solar Energy

B10: Cleaner Technologies and Life Cycle Analysis

B11: Environmental Management systems

## Appendix 2

### CompEdu Lecture Series

Each sponsor company can, upon request, receive a free copy of most of the CompEdu Lecture Series. The titles available are (so far the ones in blue have been printed in the "official" CompEdu LS format, Fig A1):

- **Bölcs Albin, 1997**  
"Transmission De Chaleur"  
Language: French
- **Bölcs Albin, 2005**  
"Transonic Flow In Turbomachines"  
CompEdu LS No. 4  
Language: English
- **Bölcs Albin, 2004**  
"Turbomachines Thermiques Vol. 1"  
Language: French
- **Bölcs Albin & Suter Peter, 1986**  
Transsonische Turbomaschinen  
Language: German
- **Bölcs Albin & Tsamourtzis Vassilious, Year???**  
Turbomachines Thermiques Vol.2 - Exercises  
Language: French
- **Erichsen Peter, 2005**  
"Spacecraft Propulsion, A Brief Introduction"  
CompEdu LS No. 13  
Language: English
- **Hölcke Jan, 2002**  
"Kompendium i Hydrauliska Strömningmaskiner"  
Language: Swedish
- **Jacquet-Richardet George, 1997**  
Bladed Assemblies Vibration  
Language: English
- **Kazachkov Ivan & Kalion Vitaly**  
"Numerical Continuum Mechanics Vol. 1 and 2"  
Language: English Vol 1 is printed now.
- **Olsson Ulf, 2005**  
"Aerospace Propulsion from Insects to Spaceplanes"  
CompEdu LS No. 3  
Language: English
- **Prisell Erik, 1998**  
Kompendium i Flygmotorteknik  
Language: Swedish
- **Teir Sebastian, 2003**  
Steam Boiler Technology  
Language: English

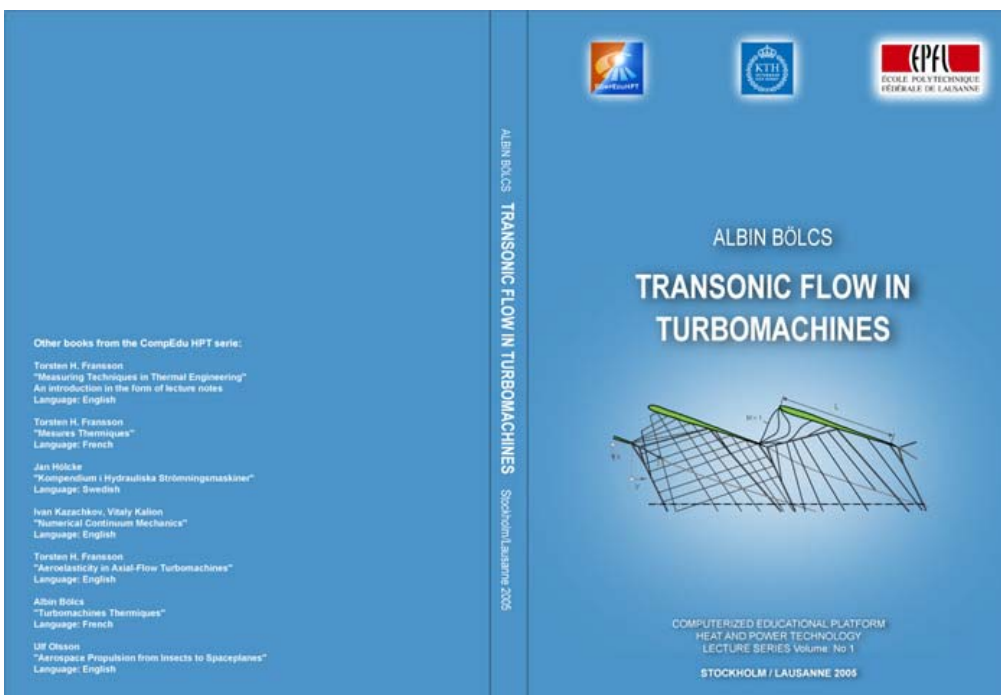


Fig. A1: CompEdu book exemplary cover

## Appendix 3

### CompEdu Lecture Notes

There are also a number of “CompEdu Lecture Notes” available. These are usually shorter and less developed than the Lecture Series:

- **Broman, Lars**  
Aquatic energy  
Language: English
- **Broman, Lars**  
Solar energy  
Language: English
- **Fransson, Torsten H**  
"Measuring Techniques in Thermal Engineering: An Introduction in the form of Lecture Notes"  
Language: English
- **Fransson, Torsten H**  
"Mesures Thermiques"  
Language: French
- **Persson, Per; Frid, Wiktor**  
"Nuclear Power"  
Language: English
- **Kjellström, Björn**  
Energy for human societies - a global perspective  
Language: English
- **Kjellström, Björn**  
Environmental impacts and hazards caused by the energy system  
Language: English
- **Kjellström, Björn**  
Potentials and technologies for utilisation of renewable energy sources  
Language: English
- **Kjellström, Björn**  
Primary energy supply and conversions to energy carriers  
Language: English
- **Salomón, Marianne; Oppong-Mensah, Richard; Guzmán, Emilio; Manson, Jim**  
"Heat And Power Cycles, An Introduction In The Form Of Lecture Notes"  
Language: English
- **Tilli, Aki**  
"Introduction to Biomass"  
Language: English

## Appendix 4

### Past and/or present sponsors – Companies



Alstom Power Switzerland

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Siemens Sweden  
Siemens USA  
Siemens Germany

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Dresser Rand

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Fortum

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Skellefteå Kraft

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Gas Turbine Efficiency AB

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Sydkraft

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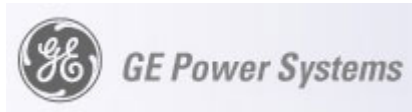
General Electric Aircraft Engines

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Turbomeca

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General Electric Power Systems

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Vattenfall

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Natole Turbine Enterprises

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Volvo Aero Corporation

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Rolls Royce UK,  
Rolls Royce USA

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Ångpanneföreningen

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## Appendix 5

### Past and/or present sponsors – Government/Foundation



Swedish Energy Agency

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Stiftelsen J. Gust. Richert

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Swedish Council for the Renewal  
of Higher Education