School of Engineering, Faculty of Applied Science

# **Creating an Open Textbook for Engineering Thermodynamics**

Presented by Dr. Claire Yan

# **Objectives**

The soaring cost of textbooks has a negative impact on students' accessibility to learning materials and academic performance.<sup>[1,2]</sup> Open education resources (OER) offer the benefits of reduced cost, improved accessibility, and better retention rate.<sup>[3]</sup>

This open textbook is published on Pressbooks, a B.C./Yukon open authoring platform hosted by Bccampus, with Creative Commons License. It can be accessed via open repositories, such as UBC cIRcle, OER Commons, Open Textbook Library, LibreTexts, and MERLOT, expanding its Thermodynamics is a fundamental subject in accessibility and fostering inclusivity in education many programs, such as engineering, physics on a global scale. It can also be downloaded in and chemistry. This project aims to different format, e.g., PDF, EPUB, HTMLBook o create an open textbook for introductory etc.

- engineering thermodynamics, containing the fundamental topics Of classical most thermodynamics suitable for an entry-level undergraduate engineering course;
- students with freely- $\circ$  provide concise, accessible alternatives commercial to textbooks, helping to reduce their financial stress;
- o create knowledge shared and develop flexible teaching and adaptive, learning material for instructors and the broader learning community.

### Introduction to Engineering Thermodynamics

#### Claire Yu Yan

The book is most suitable for a one-term, introductory ngineering thermodynamics course at the undergraduate level. It nay also be used for self-learning of fundamental concepts of assical thermodynamics.



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Figure 1: "Introduction to Engineering Thermodynamics" published on on Pressbooks with Creative Commons License.

https://pressbooks.bccampus.ca/thermo1/



# **Publishing Platform and Open** Repositories

## Table 1: Usage Statistics as of May 20, 2024

Open repository	Downloads	Views	Countries
<b>UBC</b> Library	195	202	10
<u>Open</u>			
<b>Collections</b>			
OER Commons	11	365	n/a

#### Example 2

A simplified transcritical CO<sub>2</sub> refrigeration cycle consists of four processes: compression (1 $\rightarrow$ 2), gas cooling (2 $\rightarrow$ 3), expansion (3 $\rightarrow$ 4), and evaporation (4 $\rightarrow$ 1), as shown in the P - h diagram, <u>Figure 5.3.e1</u>. The CO<sub>2</sub> gas enters the expansion valve at 10 MPa, 20°C (state 3) and is throttling to a pressure of 3 MPa (state 4). Determine the quality and temperature of CO<sub>2</sub> at state 4.



#### Figure 2: Solved examples

from a high-temperature source and reject A device that produces work continuously by absorbing heat from a hightemperature source and rejecting the waste heat to a low-temperature heat sink.

## **Book Features**

The book consists of six concise chapters tailermade for the 1<sup>st</sup> undergraduate thermodynamics course. It features

 step-by-step solved examples to help students understand key concepts (Figure 2)

• thermodynamic tables for five common fluids o user-friendly, pop-out equations and glossary,

and alt-text for accessibility (Figure 3)

 interactive H5P practice problems for students to perform self-assessment (Figure 4)

**Heat engine** is such a device that produces wor



### Figure 3: Pop-out windows for accessibility

Practice Problems		
Image: constrained and the variable of the var		
O Process 1-2		
O Process 4-5		
O Process 5-1		
O Process 2-3-4		
⊘ Check		
Question: 4 of 5 questions		
C Reuse <> Embed		

Figure 4: Interactive H5P practice problems

# **Ongoing project**

Building on this open textbook, a second project conducted by Drs. Yan, Keulen, and Dehkhoda and two graduate students, focuses on creating a problem bank using Jupyter Notebook. This project, funded by UBC's OER Accessibility Grant, aims to deepen students' understanding of thermodynamics through interactive problemsolving. The problem bank is hosted on a GitHub website and features over 50 programmable thermodynamics problems and interactive diagrams, allowing students to experiment with equations and input parameters and "visualize" the corresponding outputs and comprehend the underlying principles. https://thermo-oer-ubc.github.io/Thermo-OER/intro.html

# References

- 1. College
- Cut
- <u>cost</u>

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