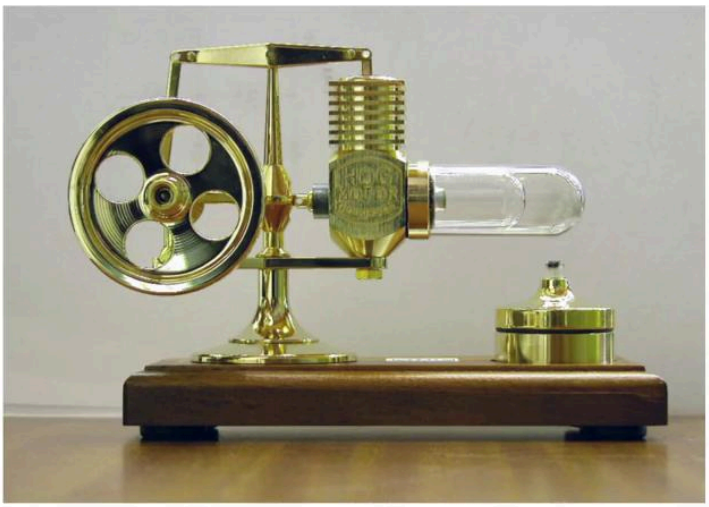
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

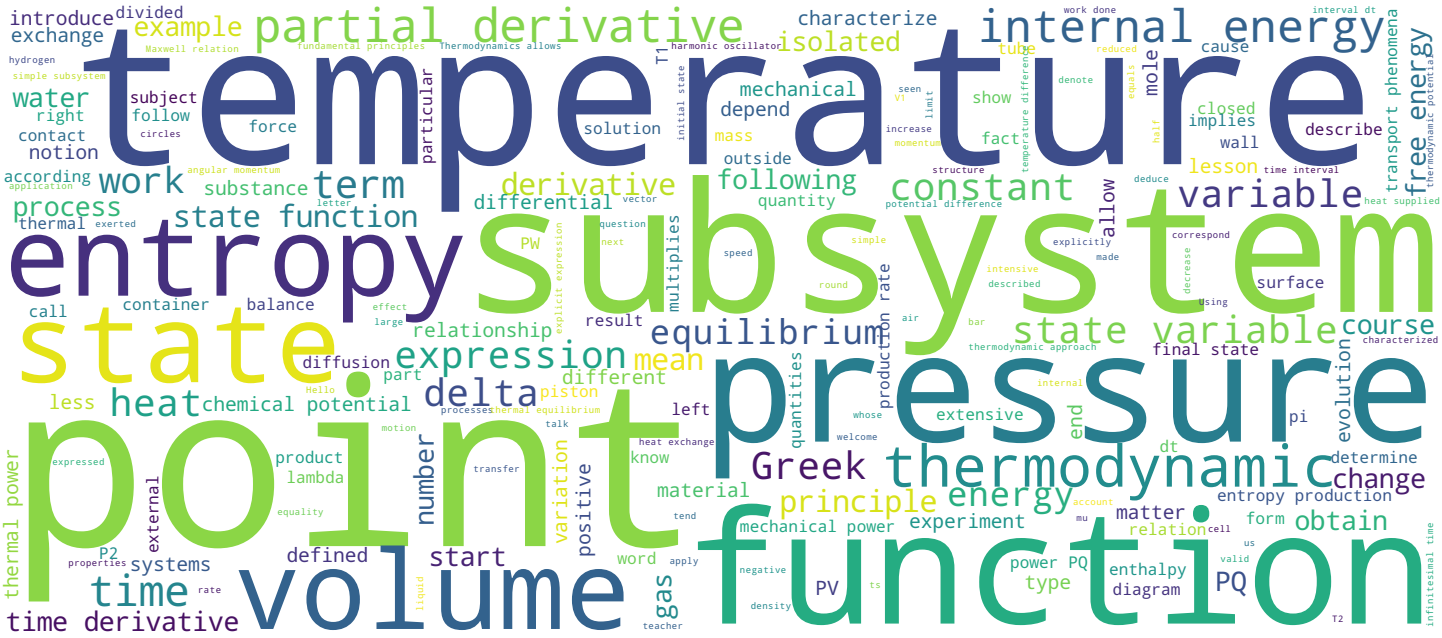
RESCIF
Réseau d'excellence des sciences de l'ingénieur de la Francophonie

Thermodynamique

Introduction générale



Prof. Jean-Philippe Ansermet



Video

EPFL

Thermodynamique

In this introductory module, I would like to show you some experiments to give you an impression of the subjects that we treat when we do thermodynamics. Let's start by looking at a machine thermal heated by the sun thanks to a parabolic mirror.

Notes

Summary

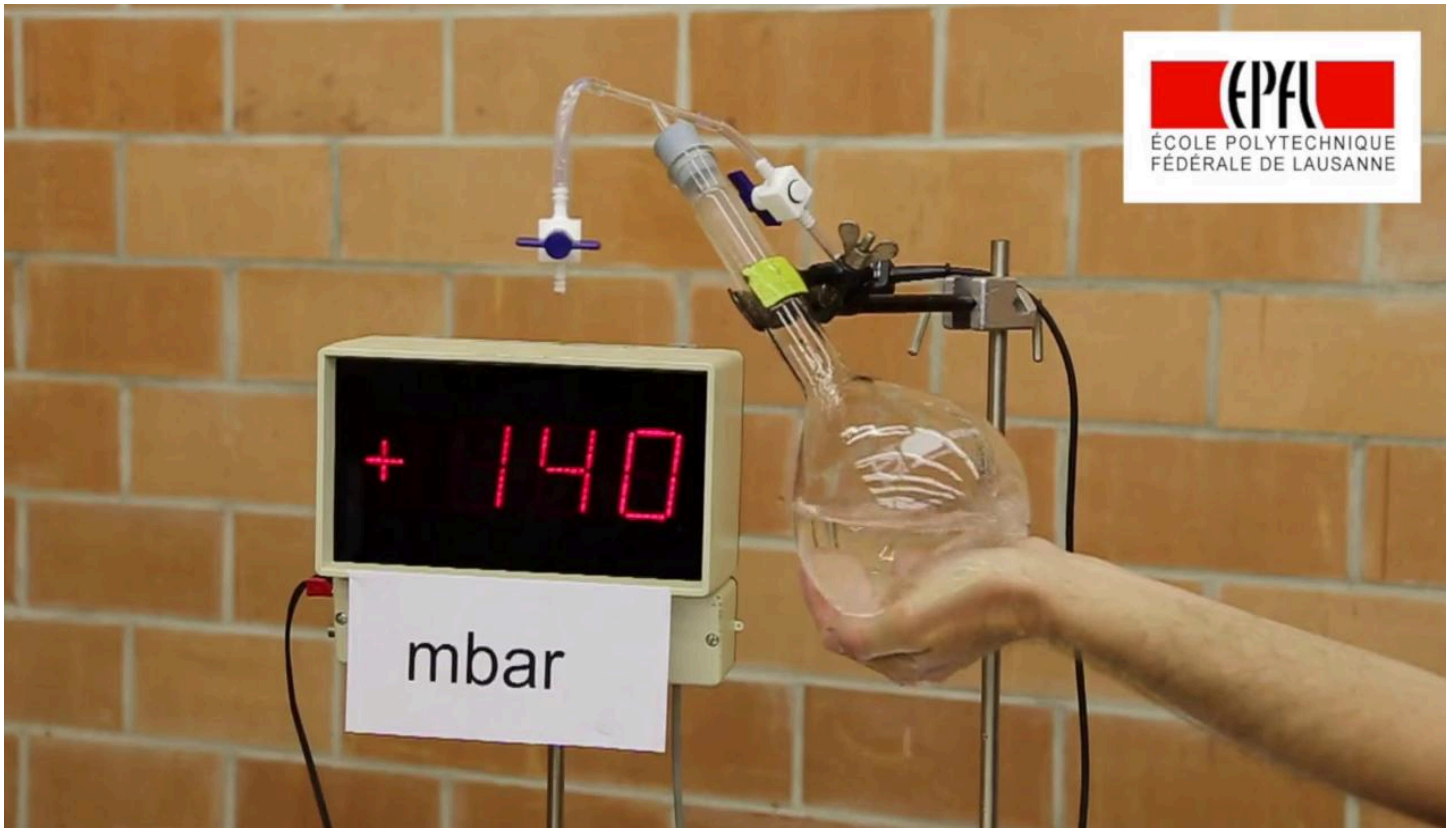
0m 05s

The heating by the effect of the radiation. This is something that needs to be quantified. The temperature of the hottest point is so large that a match ignites on contact. It is a chemical reaction. Chemistry too. This is described with a thermodynamic approach. The Stirling machine located behind the mirror transforms the thermal energy into a work, in other words a mechanical energy. The engineer must also be able to quantify this.

Notes

Summary

0m 24s



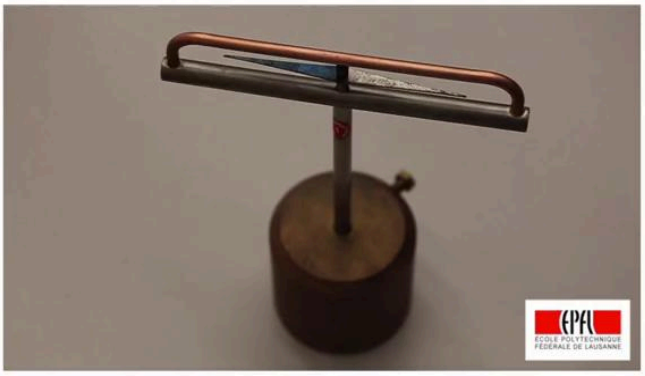
Thermodynamics allows to characterize quantitatively the properties of the substances, in particular their phase transition. Here we illustrate a classical problem. What is the pressure of water vapor as a function of its temperature? Paradoxically, in this experiment, the water is cooled by boiling it more and more because the steam pressure is reduced.

Notes

Summary

0m 58s

Effet thermoélectrique



Thermodynamique

A subject that is close to my heart is the description of transport phenomena.

Notes

Summary

1m 27s

Thermodynamics offers a unified framework to describe all kinds of phenomena, in particular thermo-electricity. Here we see that a heat input causes an electric current in the loop. This current produces a magnetic field that deflects the compass.

Notes

Summary

1m 32s

Conditions d'équilibre ?

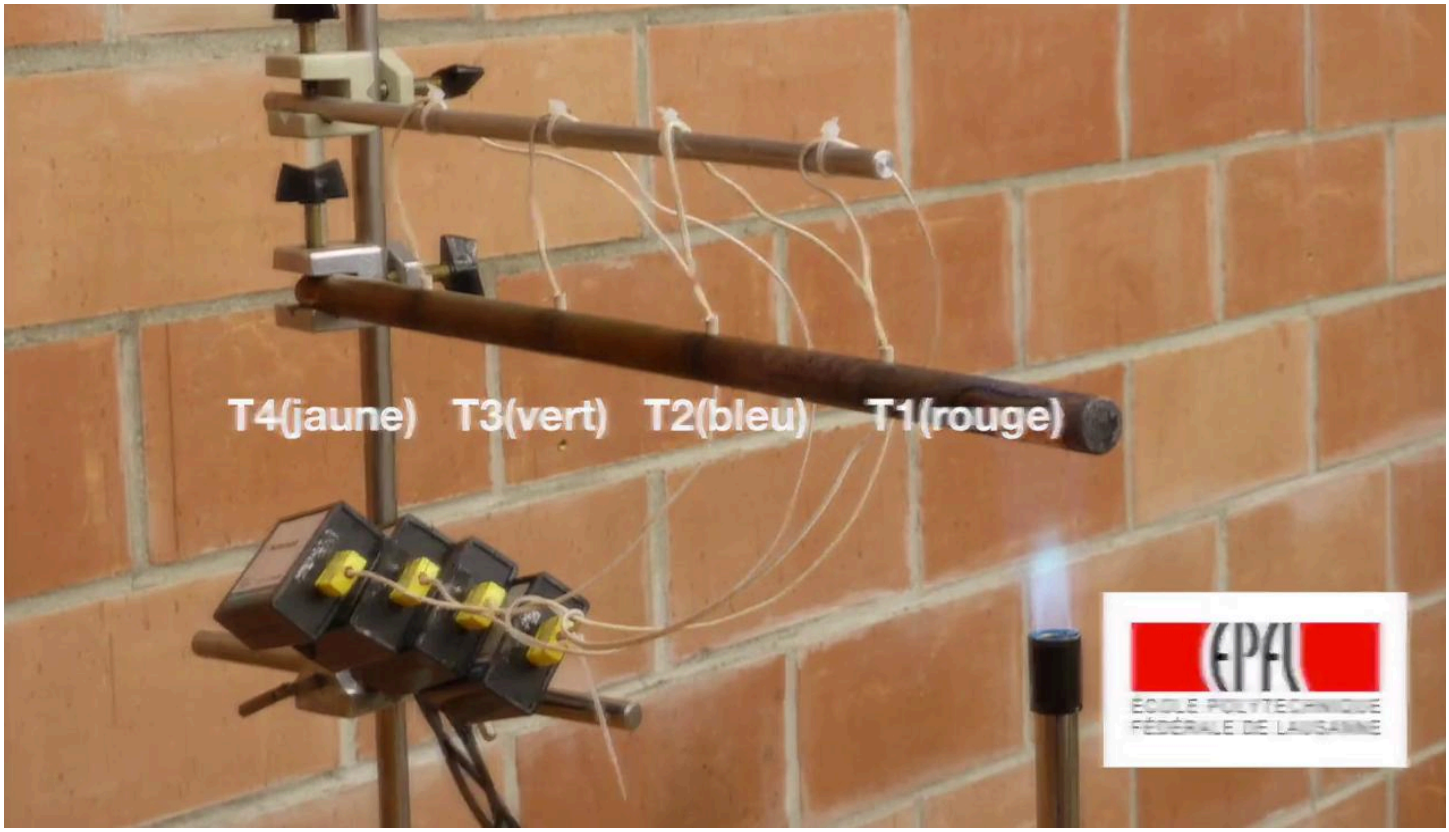
Thermodynamique

We will start this course with the question of what are the conditions thermodynamics that characterize an equilibrium.

Notes

Summary

1m 52s

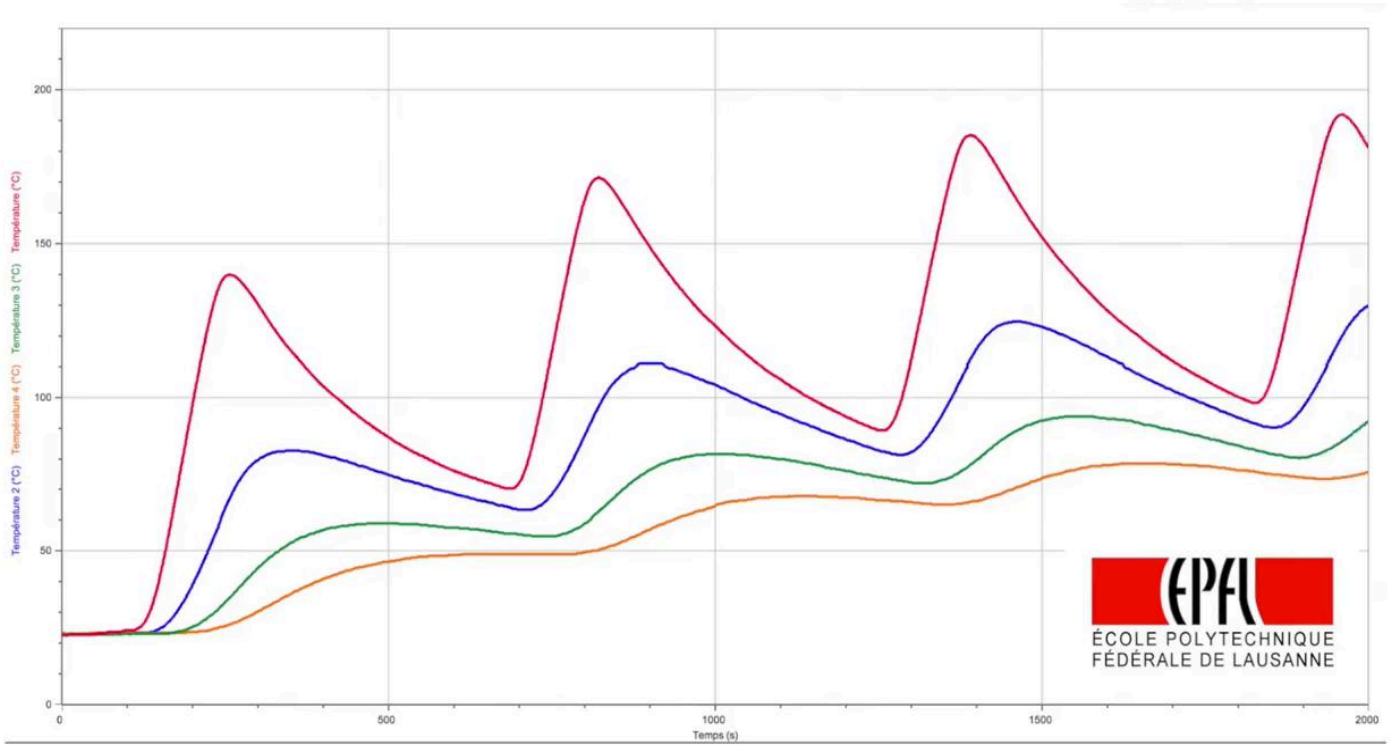


Here is a container with a porous wall. The ambient air slowly diffused inside. The U-tube shows that the pressure is the same in the container and outside. Now, we expose this system to hydrogen which is also at atmospheric pressure. We see that it is not the equality of pressures that characterizes this balance. Here is a problem of electrochemical equilibrium. We have here a solution of copper sulfate. As the color of the liquid suggests. The concentration of the solution is very different. At the bottom and top of the tube. This results in an electrical potential difference between the two electrodes. Although these electrodes are identical. Thermodynamics allows to introduce a very important differential equation, that of diffusion. Here we show the heat diffusion in a copper rod. The end of the bar is heated periodically.

Notes

Summary

2m 00s



We want to know what is the temperature as a function of time and according to the position along the bar.

Notes

Summary

3m 02s

Structure du cours

- Première partie : les fondements
  - Système thermodynamique
  - Premier principe
  - Deuxième principe
  - Transport entre 2 sous-syst.
  - Potentiels thermodynamiques
  - Relations de Maxwell

Thermodynamique

The course is divided into three parts. In the first part we state the fundamental principles of thermodynamics. We start by defining what we call a thermodynamic system. We then state the two fundamental principles of thermodynamics, of which we can immediately see an application for the transport of heat and matter between two simple subsystems. It is in this introduction that we will see also the notion of thermodynamic potential and the mathematical relations called Maxwell relations.

Notes

Summary

3m 08s

Structure du cours

- Troisième partie : phénomènes de transport
  - Milieux continus
  - Loi de Fourier
  - Loi de Fick
  - Loi d'Ohm
  - Effet Sorret
  - Effet Seebeck

Thermodynamique

The second part shows how the thermodynamic approach can be applied to various situations. It seems important to me at this stage of the training to see how this approach works on various problems. The third part of the course focuses on describing transport phenomena. We will start with a theoretical development that will allow you to better understand appreciate the structure of thermodynamics. We will obtain a result that will allow us to describe transport phenomena in a unified way. We will then see the phenomenological laws which govern the transport of heat, matter and electrical charges. The diffusion of particles in a temperature gradient and. The potential difference induced by a temperature difference.

Notes

Summary

3m 47s

Partenaires RESCIF

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Thermodynamique

The teachers of this course belong to to the network of French-speaking universities called Recif.

Notes

Summary

4m 54s

Partenaires RESCIF

I have gathered for this project faculty from five campuses on four continents. Everyone will introduce themselves when they start teaching.

Notes

Summary

5m 02s