LELME2150 – Thermal cycles

Introduction to Homework 1

Date: *September 15, 2021*

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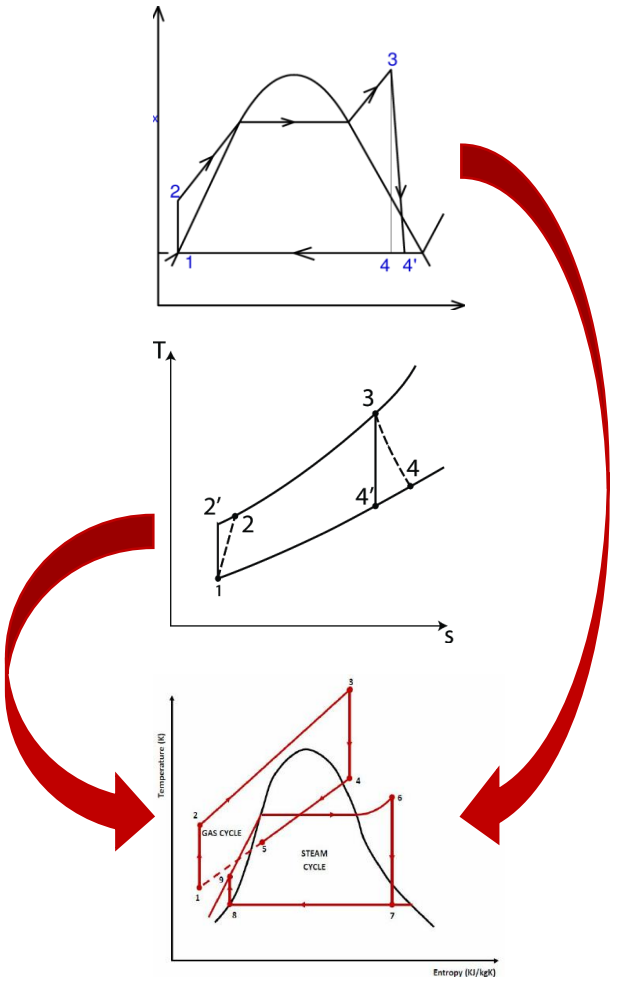
iMMC

Thermal cycles are the main driver for electricity production

- **Rankine cycles** based systems
  - Coal power plant (ST)
  - Nuclear power plant (ST)
  - *Efficiency: 33 to 40%*
- **Brayton cycles** based systems
  - Natural gas power plant (GT)
  - Oil power plant (GT/ICE)
  - *Efficiency: 35 to 43%*
- Combination of cycles
  - Combined Cycles Gas Turbine (CCGT)
  - *Efficiency: 52 to 60%*



Thermal cycles have a role to play in the energy transition

- **Production** of electricity from **renewable sources**
  - Geothermal sources
  - Concentrated solar power (CSP)
  - Use of bio-fuels and e-fuels in heat engines (*e.g. bio-gas, green hydrogen, …*)
  - Waste heat sources (*e.g. from industrial processes, from cooling systems, …*)

- Electrical energy **storage** (and sector coupling)
  - Carnot batteries (heat pumps, thermal storage and heat engines)

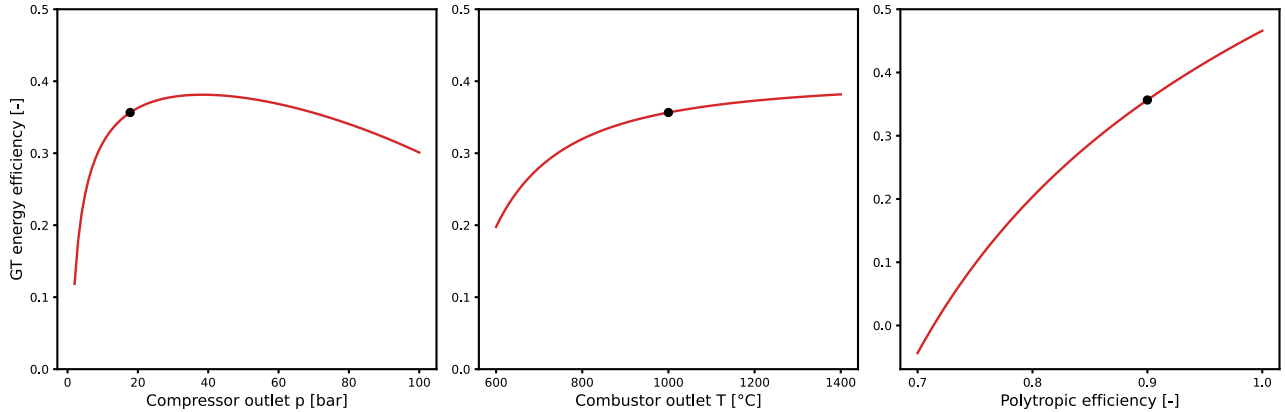
HW1 aims to take over the representation of the basic cycles

- What do you remember from your basic thermodynamic classes?
- Can you remember how to model basic Rankine and Brayton cycles?
- Can you improve some assumptions? (*e.g. constant c_p, fluid composition, …*)
- How can you conduct parametric analyses to study the cycle sensitivity to some parameters? (*e.g. ambient temperature, maximum pressure and temperature, polytropic efficiencies, …*)

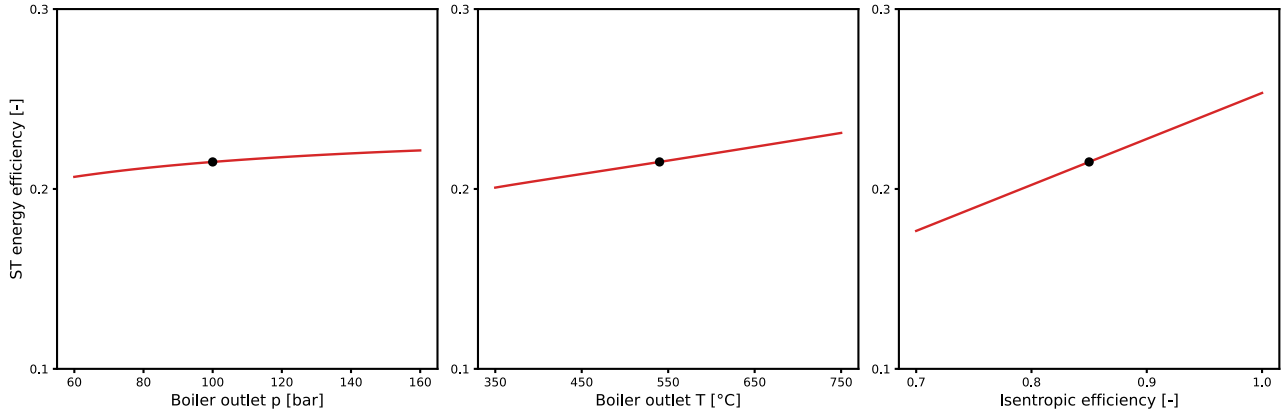
Numerical models are needed!

Start by writing the equations on a sheet and then code them in Python

- Results for GT: efficiency = 35.7% with default parameters



- Results for ST: efficiency = 21.5% with default parameters



The deadline is next Wednesday

1. Go on the Moodle page of the course (*see the announcement for the links*)
    1. Find your groupmate and select a group;
    2. Download the homework statement;
    3. Download the signatures (basic_cycles_group_xx.py);
    4. Download the test code (basic_cycles_test.py).
2. Fill the functions definitions and test your code
3. Submit one code on Moodle for your group
    basic_cycles_group_xx.py (fill your group number)

Deadline?

Wednesday the 22nd of September (S2) at 23:59 + optional Q&A session (SUD01) at 10:45 on Thursday 23rd