

TUTORIAL-4 (05 Mar 2019)
Thermodynamics for Aerospace Engineers (AS1300)

1. Which of these engines are possible? Give reason:

- (a) An engine takes heat of 1.944kWh from 500 degC reservoir and rejects heat to 100 deg C reservoir. It outputs 7MJ of work.
- (b) An engine takes heat from a reservoir at 500 deg C and rejects heat at 100 deg C, but gives output of zero J.
- (c) A heat pump operates between two reservoirs at 500 and 100 deg C but requires input of zero J.
- (d) An engine takes heat from 500 deg C reservoir and converts to work without any other reservoir.
- (e) A pump takes work of 50J and converts it to heat and transfers it to a cold reservoir, without a hot reservoir connected.
- (f) a refrigerator that takes 1A at 200 V DC to cool 1kg of water by 20 deg C in 20 sec.
- (g) A 500kW air conditioner that cools a room of 3x3x3 m of air from 30 deg C to 20 deg C, rejects 332.7kJ of heat to atmosphere in 10 min.

2. Derive a relation between the following for a simple compressible system

- (a) V and T for an isentropic process.
- (b) P and S for an isochoric process
- (c) P and S for an isothermal process
- (d) H and S for a isobaric process
- (e) T and S for an isochoric process

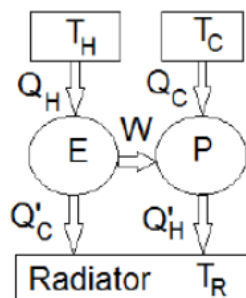
3. An engine operates between 500 deg C and 100 deg C. It takes 100kJ of energy and rejects 10kJ per cycle. Find its efficiency. Also find the Carnot cycle efficiency for the same engine. Is this engine possible?

4. Plot Carnot cycle in T-S diagram, PV diagram, PT diagram, VS diagram.

5. Plot Brayton cycle in T-S diagram, PV diagram, PT diagram, VS diagram.

Tutorial question to be solved by TMM in class.

A. A heat engine is used to drive a heat pump. The heat transfers from the heat engine and from the heat pump are used to heat water circulating through the radiators of a building. The efficiency of the heat engine is 29% and the COP of the heat pump is 3.5. Evaluate the ratio of heat transfer to the radiator water to the heat transfer to the heat engine.



B. derive an expression relating H and P for an isentropic process