Calculation Homework 2

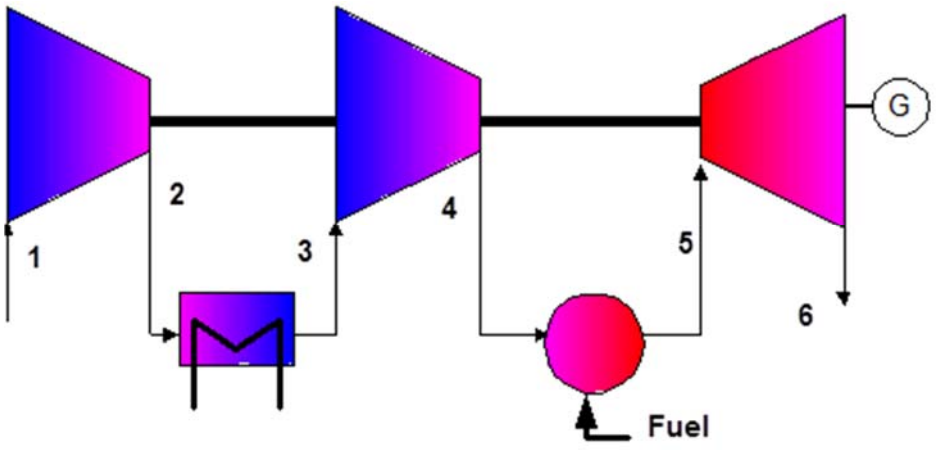
Home Assignment 2 – Gas Turbine with intercooling

The layout below shows an intercooled open-cycle gas turbine fired with light fuel oil (LFO) and driving an electrical generator. Calculate the:

- Fuel mass flow (**kg/s**)
- Net electrical power output (**kW**)
- Electrical efficiency (**%**)

The following input parameters are given:

Ambient pressure	$p_1 = p_6 = 1$ bar
Ambient temperature	$T_1 = 10$ °C
Air mass flow	$m_{air} = 100$ kg/s
Pressure ratio of first compressor	$p_2/p_1 = 5$
Pressure ratio of second compressor	$p_4/p_3 = 2$
No pressure losses in intercooler	$p_2 = p_3$
Inlet temperature second compressor	$T_3 = 30$ °C
Specific heat ratio for compressors	$k_{C1} = k_{C2} = 1.39$
Isentropic efficiency of compression	$\eta_{isC1} = \eta_{isC2} = 85\%$
Combustion pressure loss	3%
Heating value of fuel (LFO)	LHV = 42.3 MJ/kg
Stoichiometric air/fuel ratio for LFO	f = 14.52
Turbine outlet temperature	$T_6 = 550$ °C
Specific heat ratio of expansion	$k_T = 1.325$
Isentropic efficiency turbine	$\eta_{isT} = 90$ %
Mechanical shaft efficiency	$\eta_m = 97$ %
Generator efficiency	$\eta_g = 98$ %



Instructions:

There are two possible ways to handle this assignment (either one or the other):

1) A detailed solution on paper with the input parameters given above, including all equations and all sub-procedures for reaching the final results. Try to fit it into 1 sheet of paper (two sides). The paper solution can be submitted to a teacher during any SPG class event.

2) A web-based solution, where the assignment is accessed and submitted entirely online in CANVAS. The calculation results - a range of partial and final answers - shall be uploaded directly into CANVAS for an automatic check.

   In all cases, the solution procedures and any related questions can be discussed with a teacher during the homework help sessions.

For the online submittal in CANVAS - the assignment should ultimately be solved at 100% correct answers. It remains open and can be restarted unlimited number of times, until solved to 100%.

CANVAS does not function well enough yet! The online submittal option will be improved and updated while the course proceeds. Moreover, CANVAS will not grade the answers properly if any of the answer fields remains empty!

Solving all home assignments in the SPG course with 100% correct answers will provide you with 1.5 credits towards completion of the course (appearing as “ÖVN1” or “Exercise1” in the transcript).