College of Engineering

ME 203 Thermodynamic-I

Assignment 1

Due Date: 25/02/2021

Submission Guidelines

- This is an individual assignment. One submission per student is required.
- Electronic submission is accepted through the blackboard and email.
- Show the figures and tables very clearly so that it is easy to read.
- Show clearly the formula equations used with the values and proper units
- You can consult with each other, but each one must have its own independent work with own description.
- Both typed and handwritten submission is accepted.
- Submit on time. Late submission is not accepted.

Q 1 A gas in a piston–cylinder assembly undergoes a compression process for which the relation between pressure and volume is given by $\boldsymbol{pV^n = constant}$. The initial volume is 0.1 m^3, the final volume is 0.04 m^3, and the final pressure is 2 bar. Determine the initial pressure, in bar, and the work for the process, in kJ, if (a) $n = 0$, (b) $n = 1$, (c) $n = 1.3$.

Q 2 A gas contained within a piston–cylinder assembly undergoes three processes in series:
Process 1–2: Constant volume from p_1=1 bar, V_1= 4 m^3 to state 2, where p_2=2 bar.
Process 2–3: Compression to V_3=2 m^3, during which the pressure–volume relationship is pV=*constant*.
Process 3–4: Constant pressure to state 4, where V_4= 1 m^3.
Sketch the processes in series on p–V coordinates and evaluate the work for each process, in kJ.

Q 3 A gas contained in a piston–cylinder assembly undergoes two processes, A and B, between *the same end states,* 1 and 2, where $p1 = 1$ bar, $V_1 = 1$ m^3, $U_1 = 400$ kJ and $p_2 = 10$ bar, $V_2 = 0.1$ m^3, $U_2 = 450$ kJ:

Process A: Constant-volume process from state 1 to a pressure of 10 bar, followed by a constant-pressure process to state 2.

Process B: Process from 1 to 2 during which the pressure volume relation is $pV = constant$.

Kinetic and potential effects can be ignored. For each of the processes A and B, (a) sketch the process on p–V coordinates, (b) evaluate the work, in kJ, and (c) evaluate the heat transfer, in kJ.

Q 4 A gas within a piston–cylinder assembly undergoes a thermodynamic cycle consisting of three processes:

Process 1–2: Compression with $pV = constant$, from $p_1 = 1$ bar, $V_1 = 2$ m^3 to $V_2 = 0.2$ m^3, $U_2 - U_1 = 100$ kJ.

Process 2–3: Constant volume to $p_3 = p_1$.

Process 3–1: Constant-pressure and adiabatic process.

There are no significant changes in kinetic or potential energy. Determine the net work of the cycle, in kJ, and the heat transfer for process 2–3, in kJ. Is this a power cycle or a refrigeration cycle?

Q 5 For a power cycle, the heat transfers are Q_{in} =75 kJ and Q_{out} =50 kJ. Determine the network, in kJ, and the thermal efficiency.