FACULTY OF ENGINEERING AND COMPUTER SCIENCE
DEPARTMENT OF MECHANICAL ENGINEERING

ENGR-251 THERMODYNAMICS I

Student's Name: _____

I.D.: _____

Duration 60 minutes

PROBLEM 1 (50 points)

0.1 m^3 of an ideal gas is compressed from a pressure of 120 kPa and temperature of 25°C to a pressure of 1.2 MPa according to the law $PV^{1.2}$=constant. Determine:

1- The work transferred during the compression.
Note: Demonstrate the formulation of the work for a polytropic process (4 points), otherwise use the formulation:
Work for a polytropic process: $W = \frac{P_2V_2 - P_1V_1}{1-n}$

2- The change in internal energy.
3- The heat transferred during the compression.

Assume: C_v = 0.72 kJ/kg K and R=0.285 kJ/kg K

Formulas:

Ideal gas law: $P\upsilon = RT$
First law of thermodynamics for a closed system: $\Delta U = Q - W$ (neglecting ΔE_k and ΔE_p)
Specific heat at constant pressure: $C_p = \frac{\partial h}{\partial T}$
Specific heat at constant volume: $C_v = \frac{\partial u}{\partial T}$

PROBLEM 2 (50 points)

Water contained in a piston-cylinder assembly undergoes two processes in series from an initial state where the pressure is 1 MPa and the temperature is 400°C.

Process 1-2: The water is cooled as it is compressed at a constant pressure of 1 MPa to the saturated vapor state.
Process 2-3: The water is cooled at constant volume to 150°C.

1- For the overall process determine the work, in kJ/kg.
2- For the overall process determine the heat transfer, in kJ/kg.

Formulas:

Work: $W = \int_{initial\ state}^{final\ state} P\, d\upsilon$

First law of thermodynamics for a closed system: $\Delta U = Q - W$ (neglecting ΔE_k and ΔE_p)