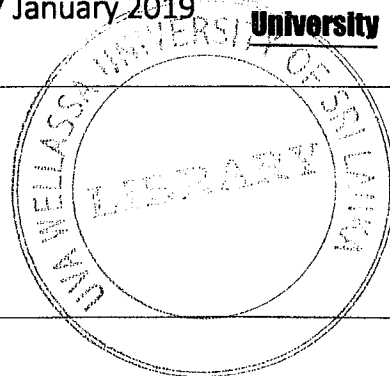


Uva Wellassa University of Sri Lanka  
Faculty of Science and Technology  
Department of Science and Technology  
200 Level 2<sup>nd</sup> Semester Examination – December 2018/ January 2019  
SCT 242-2 Engineering Thermodynamics



**Instructions to candidates**

**Duration:** Two (02) hours

**Number of questions:** Four (04)

**Mark allocation:** 100 Marks

**Answer all questions**

1.

A gas in a piston–cylinder assembly undergoes an expansion process for which the relationship between pressure and volume is given by,

$$pV^n = \text{Constant}$$

The initial pressure is 3 bar, the initial volume is  $0.1 \text{ m}^3$ , and the final volume is  $0.2 \text{ m}^3$ . Determine the work for the process, in kJ, if

- (a)  $n = 1.5$
- (b)  $n = 1.0$
- (c)  $n = 0$ .

(25 marks)

2.

A gas contained within a piston–cylinder assembly undergoes three processes in series:

Process 1–2: Constant volume from  $p_1 = 1 \text{ bar}$ ,  $V_1 = 4 \text{ m}^3$  to state 2, where  $p_2 = 2 \text{ bar}$ .

Process 2–3: Compression to  $V_3 = 2 \text{ m}^3$ , during which the pressure–volume relationship is  $pV = \text{constant}$ .

Process 3–4: Constant pressure to state 4, where  $V_4 = 1 \text{ m}^3$ .

Sketch the processes in series on  $p$ – $V$  coordinates and evaluate the work for each process, in kJ.

(25 marks)

3.

Using the tables for water, determine the specified property data at the indicated states. In each case, locate each state as points on  $p$ – $v$  and  $T$ – $v$  diagrams.

- (a) At  $p = 2 \text{ MPa}$ ,  $T = 300^\circ\text{C}$ . Find  $u$ , in kJ/kg.
- (b) At  $p = 2.5 \text{ MPa}$ ,  $T = 200^\circ\text{C}$ . Find  $u$ , in kJ/kg.
- (e) At  $p = 1.5 \text{ MPa}$ ,  $v = 0.2095 \text{ m}^3/\text{kg}$ . Find  $h$ , in kJ/kg.

(25 marks)

4.

A system consisting of 1 kg of  $\text{H}_2\text{O}$  undergoes a power cycle composed of the following processes:

Process 1–2: Constant-pressure heating at 10 bar from saturated vapor.

Process 2–3: Constant-volume cooling to  $p_3 = 5 \text{ bar}$ ,  $T_3 = 160^\circ\text{C}$ .

Process 3–4: Isothermal compression with  $Q_{34} = 2815.8 \text{ kJ}$ .

Process 4–1: Constant-volume heating.

Sketch the cycle on  $T$ – $v$  and  $p$ – $v$  diagrams. Neglecting kinetic and potential energy effects, determine the thermal efficiency.

(25 marks)