

**FINAL  
ALTERNATIVE ASSESSMENT**

(COVER PAGE)

Session : August 2020

Programme : Diploma in Mechanical Engineering (DMEN)

Course : EGM2172: Engineering Thermodynamics 1

Date of Examination : 15 December 2020 (Tuesday)

Time : 8.00am – 10.15am Reading Time : Nil

Duration : 2 Hours 15 Minutes

**Special Instructions :**

This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Material permitted : Non-Programmable Scientific Calculator

Materials provided : Thermodynamics Tables

Examiner(s) : Nur Hafizah Habideen

Chief Moderator : Iylia Elena Abdul Jamil

*This paper consists of 4 printed pages, including the cover page*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)  
EGM2172: ENGINEERING THERMODYNAMICS  
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

**Instructions:** This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions in the answer booklet. All questions carry equal marks.

**Question 1**

- (a) There is a mass of 5 kg of saturated liquid-vapor mixture of water in a piston-cylinder device at 125 kPa. Initially, 2 kg of the water is in the liquid phase and the rest is in the vapor phase. Heat is now transferred to the water, and the piston starts moving when the pressure inside reaches 300 kPa. Heat transfer continues until the total volume increases by 20 percent. Compute:
- (i) the initial and final temperatures, (8 marks)
  - (ii) the mass of liquid water when the piston first starts moving, (3 marks)
  - (iii) the work done during this process with the aid of a  $P$ - $v$  diagram. (4 marks)
- (b) Carbon steel balls with diameter of 8 mm are annealed by heating them to 900°C in a furnace, and then allowing them to cool slowly to 100°C in an ambient air at 35°C. Compute the total rate of heat transfer from the balls to the ambient air if 2500 balls are annealed per hour.

Take  $\rho_{ball} = 7833 \text{ kg/m}^3$  and  $c_p = 0.465 \text{ kJ/kg}\cdot^\circ\text{C}$ .

(10 marks)

**Question 2**

- (a) A hot-air balloon with diameter of 20 m has a mass of 80 kg when empty. This balloon is hanging still in the air at a location where the atmospheric pressure and temperature are 90 kPa and 15°C, respectively. It carries three people with mass of 65 kg each. Compute the average temperature of the air in the balloon. (12 marks)
- (b) An insulated piston cylinder device contains 0.05 m<sup>3</sup> of saturated refrigerant-134a vapor at a pressure of 0.8 MPa. The refrigerant is allowed to expand in a reversible manner until the pressure drops to 0.4 MPa. Compute:
- (i) the final temperature in the cylinder, (8 marks)
- (ii) the work done by the refrigerant. (5 marks)

**Question 3**

- (a) An adiabatic steam turbine is used to drive a generator that powers the air compressor. Steam enters the turbine at 12.5 MPa and 500°C at a rate of 25 kg/s and exits at 10 kPa and a quality of 0.92. Air enters the compressor at 98 kPa and 295 K at a rate of 10 kg/s and exits at 1 MPa and 620 K. Compute the net power delivered to the generator by the turbine. (15 marks)
- (b) Radiators are heat exchangers used to transfer thermal energy from one medium to another for the purpose of cooling and heating.
- (i) Explain whether the radiator should be analysed as a closed system or as an open system. (3 marks)
- (ii) Are radiators steady flow devices? Explain. (3 marks)
- (iii) Explain the thermal energy transfers in terms of energy balance. (4 marks)

**Question 4**

- (a) A Carnot refrigeration cycle is executed in a closed system under the saturated liquid–vapor mixture region. The working fluid is refrigerant-134a with mass of 0.96 kg. The maximum absolute temperature in the cycle is 1.2 times the minimum absolute temperature, and the net work input to the cycle is 22 kJ. With the aid of  $T$ - $v$  diagram, compute the minimum pressure in the cycle, if the refrigerant changes from saturated vapor to saturated liquid during the heat rejection process.

(16 marks)

- (b) A household refrigerator has a power input of 450 W and a COP of 2.5. It is used to cool five large watermelons, 10 kg each, to 8°C. Compute how long it will take for the refrigerator to cool them, if the watermelons are initially at 20°C.

Take  $c_{\text{watermelon}} = 4.2 \text{ kJ/kg}\cdot^{\circ}\text{C}$

(9 marks)

**~THE END~**

*EGM2172 (F)/ August 2020 Session/ formatted*