FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**August 2020**
Programme	:	Diploma in Mechanical Engineering (DMEN)
Course	:	**EGM2181: Engineering Thermodynamics 2**
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)
EGM2181: ENGINEERING THERMODYNAMICS 2
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

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Question 1

A regenerative gas-turbine engine operates with two stages of compression and two stages of expansion. The pressure ratio across each stage of the compressor and turbine is 3.5. The air enters each stage of the compressor at 300 K and each stage of the turbine at 1200 K. The compressor and turbine efficiencies are 78 % and 86 %, respectively. The effectiveness of the regenerator is 72 %. Assuming constant specific heats, compute:

(a) the back work ratio,

(19 marks)

(b) the thermal efficiency of the cycle.

(6 marks)

Question 2

A steam power plant operates on an ideal Rankine cycle with two stages of reheat and has a net power output of 120 MW. Steam enters all three stages of the turbine at 500°C. The maximum pressure in the cycle is 15 MPa, and the minimum pressure is 5 kPa. Steam is reheated at 5 MPa the first time and at 1 MPa the second time.

(a) Show the cycle on a *T*-*s* diagram with respect to saturation lines.

(2 marks)

(b) Compute the thermal efficiency of the cycle.

(21 marks)

(c) Compute the mass flow rate of the steam.

(2 marks)

Question 3

(a) A large refrigeration plant is maintained at -15°C, and requires refrigeration at a rate of 100 kW. The condenser of the plant is to be cooled by liquid water, which experiences a temperature rise of 8°C as it flows over the coils of the condenser. The compressor has an isentropic efficiency of 75 %. Assuming the plant operates on the ideal vapor-compression cycle using refrigerant-134a between the pressure limits of 120 and 700 kPa, compute:

(i) the mass flow rate of the refrigerant,

(5 marks)

(ii) the power input to the compressor,

(4 marks)

(iii) the mass flow rate of the cooling water.

(4 marks)

(b) An air-conditioning system operates at a pressure of 1 atm and consists of a heating section and an evaporative cooler. Air enters the heating section at 10°C and 70 % relative humidity at a rate of 30 m^3/min, and it leaves the evaporative cooler at 20°C and 60 % relative humidity. Compute:

(i) the temperature and relative humidity of the air when it leaves the heating section,

(5 marks)

(ii) the rate of heat transfer in the heating section,

(3 marks)

(iii) the rate of water added to air in the evaporative cooler.

(4 marks)

Question 4

(a) A certain coal has the following analysis on a mass basis:
82 % C, 5 % H_2O, 2 % H_2, 1 % O_2, and 10 % ash.

The coal is burned with 50 % excess air. Compute the air–fuel ratio.

(13 marks)

(b) A single cylinder reciprocating compressor has a bore of 120 mm and a stroke of 150 mm with a speed of 1200 rpm. CO_2 gas is compressed from a pressure of 120 kPa and temperature of 20°C to a temperature of 215°C. Assuming polytropic compression, $n = 1.3$ with no clearance and volumetric efficiency of 100%, calculate:

(i) pressure ratio,

(3 marks)

(ii) indicated power,

(5 marks)

(iii) shaft power with mechanical efficiency of 80 %,

(2 marks)

(iv) mass flow rate of CO_2 gas.

(2 marks)

~THE END~

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