INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**April 2019**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**EGM2181 : Engineering Thermodynamics 2**
Date of Examination	:	August 3, 2019 (Saturday)
Time	:	11:00 am – 1:00 pm Reading Time: Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks. **Those attempting question 4, please attached the Psychrometric Chart to the answer booklet.**

Materials permitted : Non-Programmable Calculator

Materials provided : Thermodynamics and Transport Properties of Fluids,Property Tables and Charts (SI Units) & Psychrometric Chart

Examiner (s)	:	**Dr Aaron Edward Teo** and Soo Swee Yoong
Moderator	:	Dr Ing Al-Hassan Tijani

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

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGM2181: ENGINEERING THERMODYNAMICS 2
FINAL EXAMINATION: APRIL 2019 SESSION

Instructions: This paper consist of SIX **(6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Consider a 210-MW steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 10 MPa and 500°C and is cooled in the condenser at a pressure of 10 kPa.

(i) Show the cycle on a T-s diagram with respect to saturation lines,
(3 marks)

(ii) Determine the quality of the steam at the turbine exit,
(11 marks)

(iii) Determine the thermal efficiency of the cycle,
(8 marks)

(iv) Determine the mass flow rate of the steam.
(3 marks)

Question 2

(a) At the beginning of compression of an ideal Diesel cycle the gas has a temperature and pressure of 40 °C and 90kPa, respectively. The volume ratio of compression is 16:1. The maximum temperature of the cycle is 1400 °C. Applying the cold air standard assumptions and taking C_p = 1.005 kJ/kgK, C_v = 0.718 kJ.kgK, R = 0.287 kJ/kgK and k = 1.4, sketch the P-v, T-s diagrams and determine for the cycle:

(i) The pressure and temperature at each of the cycle process change points,
(12 marks)

(ii) The work done in kJ/kg,
(3 marks)

(iii) The thermal efficiency,
(3 marks)

(iv) The mean effective pressure,
(3 marks)

(v) The Carnot efficiency within the cycle temperature limit.
(3 marks)

Question 3

A refrigerator uses refrigerant-134a as the working fluid and operates on the ideal vapor-compression refrigeration cycle. The refrigerant enters the evaporator at 120 kPa with a quality of 30 percent and leaves the compressor at 60°C. If the compressor consumes 450 W of power, determine

(i) The condenser pressure,

(7 marks)

(ii) The mass flow rate of the refrigerant,

(9 marks)

(iii) The COP of the refrigerator,

(5 marks)

(iv) Sketch the Schematic diagram and the T-s diagram for the refrigeration cycle.

(4 marks)

Question 4

(a) A room contains air at 20°C and 98 kPa at a relative humidity of 85 percent. Determine,

(i) The partial pressure of dry air,

(3 marks)

(ii) The specific humidity of the air,

(3 marks)

(iii) The enthalpy per unit mass of dry air.

(3 marks)

(b) Air enters a 30 cm diameter cooling section at 1 atm., 35°C and 45% relative humidity at 18 m/s. Heat is removed from the air at a rate of 750 kJ/min. Using psychometric chart, determine:

(i) The exit temperature,

(13 marks)

(ii) The exit relative humidity of the air,

(1 mark)

(iii) The exit velocity.

(3 marks)

Question 5

(a) A single stage, single-acting, reciprocating air compressor has a bore of 200 mm and a stroke of 300 mm. It runs at a speed of 500 rev/min. The clearance volume is 5% of the swept volume and the polytropic index is 1.3 throughout. Intake pressure and temperature are 97 kPa and 20°C, respectively, and the compression pressure is 550 kPa. Sketch the P-v diagram for the above and determine:

(i) The free air delivered in m^3/min (free air condition 101.325 kPa and 15°C),

(15 marks)

(ii) The volumetric efficiency referred to the free air conditions,

(2 marks)

(iii) The air delivery temperature,

(2 marks)

(iv) The cycle power,

(3 marks)

(v) The isothermal efficiency, neglecting clearance.

(3 marks)

Question 6

(a) Methane (CH_4) is burned with stoichiometric amount of air during a combustion process. Assuming complete combustion, determine the:

(i) Air–fuel ratio,

(ii) Fuel–air ratio.

(13 marks)

(b) In a combustion chamber, ethane (C_2H_6) is burned at a rate of 8 kg/h with air that enters the combustion chamber at a rate of 176 kg/h. Determine the percentage of excess air used during this process.

(12 marks)

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