UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	THERMODYNAMICS 2
COURSE CODE	:	BDA 30403
PROGRAMME	:	BDD
EXAMINATION DATE	:	JULY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	**PART A**: ANSWER **TWO (2)** QUESTIONS **ONLY** FROM **THREE (3)** QUESTIONS. **PART B**: ANSWER **ALL** QUESTIONS.

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

PART A: ANSWER TWO (2) QUESTIONS ONLY FROM THREE (3) QUESTIONS.

Q1 (a) Differentiate between open feedwater heaters and closed feedwater heaters.

(3 marks)

(b) Consider a coal-fired steam power plant that produces 300 MW of electric power. The power plant operates on a simple ideal Rankine cycle with turbine inlet conditions of 5 MPa and 450°C and a condenser pressure of 25 kPa. The coal has a heating value (energy released when the fuel is burned) of 29,300 kJ/kg. Assuming that 75 percent of this energy is transferred to the steam in the boiler and that the electric generator has an efficiency of 96 percent, determine;

(i) the overall plant efficiency (the ratio of net electric power output to the energy input as fuel); and

(ii) the required rate of coal supply.

(17 marks)

Q2 (a) An aviation machine can use gas turbines as the main propulsion system. Elaborate the advantages of this selection.

(4 marks)

(b) Helium is used as the working fluid in an ideal Brayton cycle. Gas enters the compressor at 27°C and 20 bar and is discharged at 60 bar. The gas is heated to 1000 °C before entering the turbine. The cooler returns the hot turbine exhaust to the temperature of the compressor inlet. Take C_p = 5.1926 kJ/kg.K. Determine;

(i) the temperatures at the end of compression and expansion;

(ii) the heat supplied, the heat rejected and the net work per kg of He; and

(iii) the cycle efficiency and the heat rate.

(16 marks)

Q3 (a) Describe the free air delivery (FAD).

(3 marks)

(b) A single stage double-acting air compressor is required to deliver 14 m^3 of air per minute measured at 1 bar and 15°C. The delivery pressure is 7 bar and the speed is 300 rpm. The index of compressor and expansion is 1.3. Determine;

i) the swept volume of the cylinder;
ii) the delivery temperature;
iii) the indicated power;
iv) the volumetric efficiency; and
v) the dimension of the cylinder if L to D ratio = 1.5 :1.

For (a) without clearance, (b) with clearance volume as 5 % of the swept volume.

(17 marks)

PART B: ANSWER ALL QUESTIONS.

Q4 (a) Explain the term isentropic compressor.

(2 marks)

(b) A two-stage compression refrigeration system with an adiabatic liquid-vapor separation unit uses refrigerant-134a as working fluid. The system operates the evaporator at 0.4 MPa, the condenser at 1.6 MPa, and the separator at 0.8 MPa. The compressors use 25 kW of power. Given that the refrigerant is saturated liquid at the inlet of each expansion valve and saturated vapor at the inlet of each compressor, and the compressors are isentropic;

(i) show the process on a T-s diagram;

(ii) calculate the rate of cooling provided by the evaporator, the COP of the heat pump; and

(iii) determine the COP of this cycle.

(18 marks)

Q5 (a) Describe the internal combustion engine and state the two broad classification of their combustion processes.

(3 marks)

(b) The maximum cycle temperature and compression ratio of an ideal Otto cycle with air as working fluid is 1060K and 7, respectively. The specified condition of the working fluid at the beginning of compression is 305K and 83 kPa. Determine;

i) the heat rejection;

ii) the net work; and

iii) the thermal efficiency.

(17 marks)

Q6 (a) Differentiate between natural-draft and forced-draft cooling tower.

(4 marks)

(b) Water enters a cooling tower at 35 °C and at a rate of 1.4 kg/s and leaves at 25 °C. Humid air enters this tower at 1 atm and 17 °C with a relative humidity of 30 percent and leaves at 22 °C with a relative humidity of 80 %. Using appropriate sketches, determine the mass flow rate of dry air through this tower.

(16 marks)

– END OF QUESTION –

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