UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	THERMODYNAMICS II
COURSE CODE	:	BDA30403 / BDA3043
PROGRAMME	:	BDD
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONTAINS **SIX (6)** PAGES

Q1 (a) With an appropriate sketch, explain why is the Carnot cycle not a realistic model for steam power plants.

(3 marks)

(b) Explain why an excessive moisture in steam undesirable in steam turbines and give the highest moisture content allowed.

(2 marks)

(c) A steam power plant operates on an ideal reheat– regenerative Rankine cycle and has a net power output of 80 MW. Steam enters the high-pressure turbine at 10 MPa and 550°C and leaves at 0.8 MPa. Some steam is extracted at this pressure to heat the feedwater in an open feedwater heater. The rest of the steam is reheated to 500°C and cooled in the condenser at a pressure of 10 kPa by running cooling water from a lake through the tubes of the condenser at a rate of 2000 kg/s.

(i) Show the cycle on a T-s diagram with respect to saturation lines.
(ii) Determine the mass flow rate of steam through the boiler.
(iii) Calculate the net power output of the plant
(iv) Determine the temperature rise of the cooling water.

(20 marks)

Q2 (a) Define the effectiveness of a regenerator used in gas-turbine cycles.

(2 marks)

(b) For fixed maximum and minimum temperatures, describe the effect of the pressure ratio on (i) the thermal efficiency and (ii) the net work output of a simple ideal Brayton cycle?

(3 marks)

(c) Explain what the back work ratio is and what are typical back work ratio values for gas-turbine engines

(2 marks)

(d) A gas-turbine power plant operates on the regenerative Brayton cycle between the pressure limits of 100 and 700 kPa. Air enters the compressor at 30°C at a rate of 12.6 kg/s and leaves at 260°C. It is then heated in a regenerator to 400°C by the hot combustion gases leaving the turbine. A diesel fuel with a heating value of 42,000 kJ/kg is burned in the combustion chamber with a combustion efficiency of 97 percent. The combustion gases leave the combustion chamber at 871°C and enter the turbine whose isentropic efficiency is 85 percent. Treating combustion gases as air and using constant specific heats at 500°C, determine

(i) the isentropic efficiency of the compressor,
(ii) the effectiveness of the regenerator,
(iii) the air–fuel ratio in the combustion chamber,
(iv) the net power output and the back work ratio and
(v) the thermal efficiency

(18 marks)

Q3 (a) Explain the operating cycle of two-stage compressor and sketch the thermodynamics analysis on a p-v diagram for both compression processes. Explain the phenomena of the intercooling system that influences to the work saved during the compression process.

(4 marks)

(b) Define the volumetric efficiency and discuss the influences of the effect of clearance volume between head and TDC of piston during compression process. The explanations should be focused on the operating cycle, thermodynamics aspects and their relatives merits and demerits.

(4 marks)

(c) A single-acting, two-stage reciprocating air compressor has a pressure ratio of 10 to 1 and takes 5.5kg of air per minutes. The air is compressed from 1.013 bar and 18^0C. During operation, the law of compression and expansion in both stages is $pV^{1.3}$ = constant and both stages have same pressure ratio. If intercooling is complete, calculate the indicated power and the cylinder swept volumes required. Assume that the clearance volumes of both stages are 6% of their respective swept volumes and that the compressor runs at 350 rev/min. Sketch schematic and *P-v* diagram for the above operation.

(17 marks)

Q4 (a) Using appropriate sketches draw a two-stage refrigeration system with a flash chamber. Explain briefly the function of flash chamber in this system.

(5 marks)

(b) A two-stage compression refrigeration system operates with refrigerant-134a between the pressure limits of 1.4 and 0.10 MPa. The refrigerant leaves the condenser as a saturated liquid and is throttled to a flash chamber operating at 0.6 MPa. The refrigerant leaving the low-pressure compressor at 0.6 MPa is also routed to the flash chamber. The vapor in the flash chamber is then compressed to the condenser pressure by the high-pressure compressor, and the liquid is throttled to the evaporator pressure. Assuming the refrigerant leaves the evaporator as saturated vapor and both compressors are isentropic, determine

(i) the fraction of the refrigerant that evaporates as it is throttled to the flash chamber,
(ii) the rate of heat removed from the refrigerated space for a mass flow rate of 0.25 kg/s through the condenser, and
(iii) the coefficient of performance

(20 marks)

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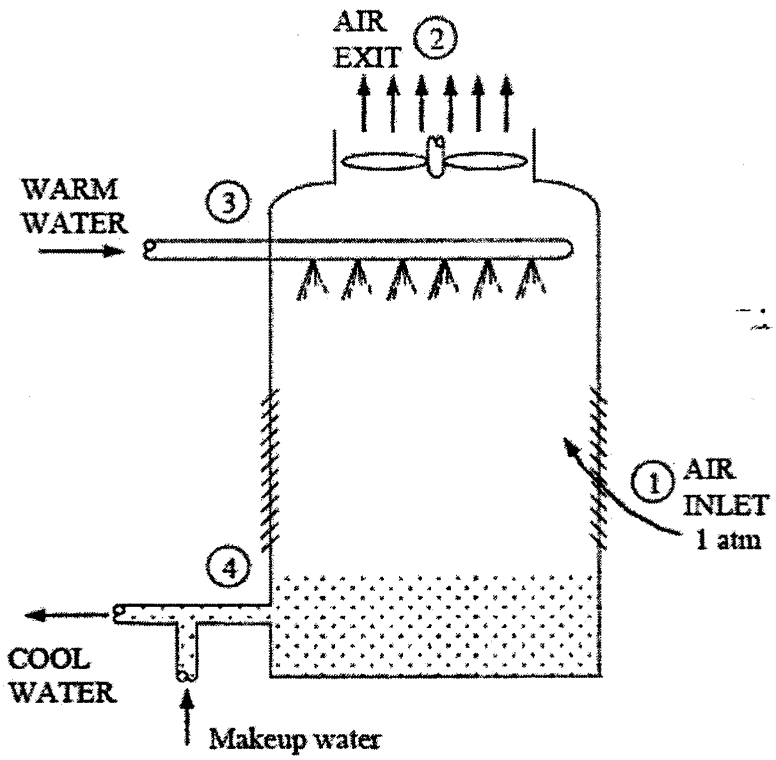

FIGURE Q6

END OF QUESTION