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SET B

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2010 SESSION

SUBJECT CODE	:	FRB 15102
SUBJECT TITLE	:	THERMODYNAMICS
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00am – 11.00am (2 HOURS)
DATE	:	08 MAY 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of FIVE (5) questions. Answer FOUR (4) questions only.
6. Answer ALL questions in English.

THERE ARE 3 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer ONLY FOUR (4) questions

Please use the answer booklet provided.

Question 1

Air is used as the working fluid in a simple ideal Brayton cycle that has a pressure ratio of 12, a compressor inlet temperature of 300 K, and a turbine inlet temperature of 1000 K. By using constant specific heat at the room temperature, calculate the required mass flow rate of air for a net power output of 70 kW if:

(a) Both the compressor and the turbine isentropic efficiency is 100%.

(10 marks)

(b) Both the compressor and the turbine isentropic efficiency is 85%

(15 marks)

Question 2

A stationary gas-turbine power plant operates on a simple Brayton cycle with air as the working fluid. The air enters the compressor at 95 kPa and 290 K and the turbine at 760 kPa and 1100 K. Heat is transferred to air at a rate of 35,000 kJ/s. Calculate the net power delivered by this plant by using:

(c) Constant specific heat at the room temperature.

(10 marks)

(d) Variable specific heat with temperature

(15 marks)

Question 3

Consider a steam power plant that operates on the ideal reheat Rankine cycle. The plant maintains the boiler at 4000 kPa, the reheat section at 500 kPa, and the condenser at 10 kPa as in Figure Q3. The mixture quality at the exit of both turbine is 90%. Determine:

(a) The temperature at the inlet of each turbine.

(15 marks)

(b) The cycle's thermal efficiency.

(15 marks)

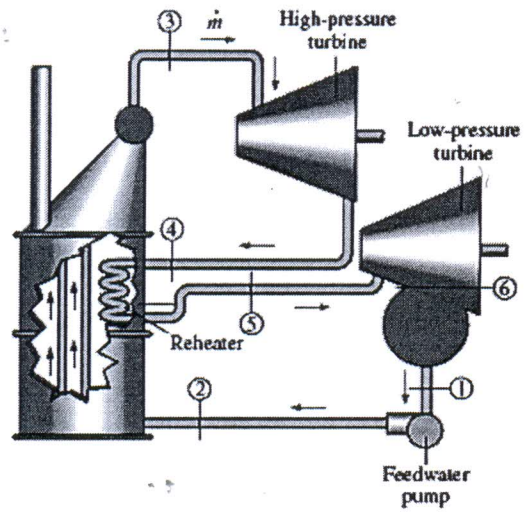

Figure Q3 Schematic of a reheat Rankine cycle

Question 4

A two-stage cascade refrigeration system is to provide cooling at -40° C while operating the high temperature condenser at 1.6 MPa as in Figure Q4. Each stage operates on the ideal vapour-compression refrigeration cycle (VCRS). The upper vapour compression system (VCRS) uses water as its working fluid and operates its evaporator at 5° C. The lower cycle uses R-134a as its working fluid and operates its condenser at 400 kPa. This system produces a cooling effect of 20 kJ/s. Determine:

(a) The mass flow rate of R-134a.

(8 marks)

(b) The mass flow rate of water.

(8 marks)

(c) C.O.P. of the whole system.

(9 marks)

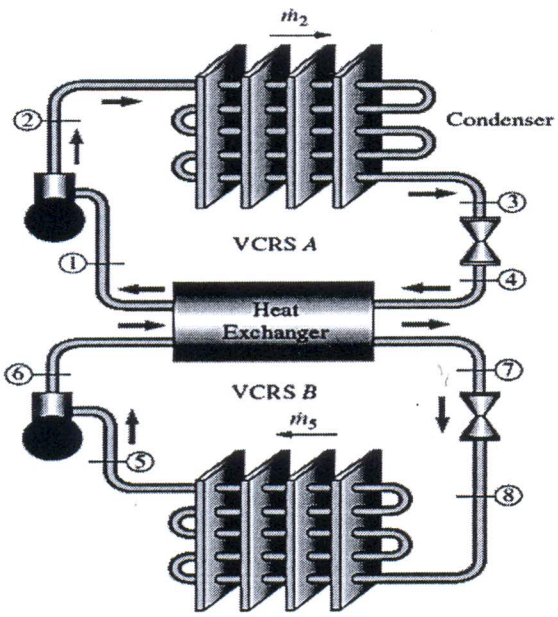

Figure Q4 Schematic of a cascade system

Question 5

Air (cp = 1.005 kJ/kg · °C) is to be preheated by hot exhaust gases in a cross-flow heat exchanger before it enters the furnace. Air enters the heat exchanger at 95 kPa and 20°C at a rate of 1.6 m3/s. The combustion gases (cp = 1.10 kJ/kg · °C) enter at 180°C at a rate of 2.2 kg/s and leave at 95°C. Determine:

(a) The rate of heat transfer to the air.

(8 marks)

(b) The outlet temperature of the air.

(8 marks)

(c) The rate of entropy generation.

(9 marks)

END OF QUESTION