UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION

JANUARY 2016 SEMESTER

COURSE CODE	:	JFB 20303
COURSE TITLE	:	HVAC 1: APPLIED THERMODYNAMICS & AIR CONDITIONING SYSTEM
PROGRAMME LEVEL	:	BACHELOR
DATE	:	18 MAY 2016
TIME	:	9.00 AM – 12.00 PM
DURATION	:	3 HOURS

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. This question paper consists of FIVE (5) questions.
4. Answer FOUR (4) questions only.
5. Please write your answers on the answer booklet provided.
6. Table and formula are enclosed as reference.
7. Please answer all questions in English only.

THERE ARE 3 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

Total: 100 marks

INSTRUCTION: Answer FOUR (4) questions only.
Please use the answer sheet provided.

Question 1

A computer chip must be cooled by the flow of air over its top surface. The chip is square and has a flat surface with 5 mm width. It is connected to the computer by a plastic film so that it is well insulated on the bottom and the sides. The temperature of the surroundings is 15^0C and the maximum temperature to use the chip is 85^0C. Given that the convection heat transfer coefficient is 50 W/m^2.K and has a surface emissivity of 0.9.

(a) Determine the rate of radiation, convection and total of heat transfer from the chip.

(8 marks)

(b) Calculate the temperature of the surroundings if the total rate of heat loss is increased to 0.4 W.

(9 marks)

(c) Evaluate the total rate of heat loss from the chip if the coolant is changed to a liquid with convection coefficient of 300 W/m^2.K and surrounding temperature of 20^0C.

(8 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 75 MW. Steam enters all three stages of the turbine at 500^0C. The maximum pressure in the cycle is 9.5 MPa, and the minimum pressure is 30 kPa. Steam is reheated at 4.0 MPa the first time and at 2.0 MPa the second time. By using the T-s diagram with respect to saturation lines,

(a) Calculate the thermal efficiency of the cycle.

(18 marks)

(b) Identify the mass flow rate of the steam.

(7 marks)

Question 3

(a) The air in a room has a pressure of 1 atm, a dry-bulb temperature of 24°C, and a wet-bulb temperature of 17°C. By using the psychrometric chart, determine the specific humidity, enthalpy, relative humidity, dew-point temperature, and specific volume of the air.

(6 marks)

(b) Two airstreams are mixed steadily and adiabatically. The first stream enters at 32°C and 40 percent relative humidity at a rate of 15 m^3/min, while the second stream enters at 12°C and 90 percent relative humidity at a rate of 25 m^3/min. Assuming that the mixing process occurs at a pressure of 1 atm. By analyzing the question, calculate the specific humidity, relative humidity, dry-bulb temperature, and volume flow rate of the mixture.

(19 marks)

Question 4

(a) With the aid of a diagram, discuss the differences of a refrigeration system and a heat pump system.

(8 marks)

(b) Refrigerant-134a enters the compressor of a refrigerator as superheated vapor at 0.20 MPa and 25°C at a rate of 0.07 kg/s, and it leaves at 1.2 MPa and 70°C. The refrigerant is cooled in the condenser to 44°C and 1.15 MPa, and it is throttled to 0.21 MPa. Disregarding any heat transfer and pressure drops in the connecting lines between the components, by using show the cycle on a T-s diagram with respect to saturation lines.

i. Calculate the rate of heat removal from the refrigerated space and the power input to the compressor.

(7 marks)

ii. Analyze the isentropic efficiency of the compressor and the COP of the refrigerator.

(10 marks)

Question 5

(a) Human beings want to feel the comfortable and live in an environment that is neither hot nor cold, neither humid nor dry. Discuss the **THREE (3)** factors that affected the comfort of the human body.

(9 marks)

(b) A building requires a 2 ton heat pump for maintaining the interior space at 27°C when the outside temperature is 5°C. The heat pump operates on the normal vapour compression refrigeration cycle and uses refrigerant-134a as the working fluid. The heat pump operating conditions require an evaporator pressure of 240 kPa and a condenser pressure of 1600 kPa while the compressor has an isentropic efficiency of 85 percent.

i. Sketch the hardware and the T-s diagram for the heat pump system.

(4 marks)

ii. Identify the power required to drive the heat pump in kW and the COP of the refrigerator.

(12 marks)

END OF EXAMINATION PAPER