Document No :UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FVB 20903
SUBJECT TITLE	:	ENGINEERING SCIENCE 1
LEVEL	:	BACHELOR
TIME / DURATION	:	2.5 HOURS 3.30 pm - 6.00 pm
DATE	:	02 JUN 2014

INSTRUCTIONS TO CANDIDATES

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

THERE ARE 3 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FIVE (5) questions only.

Question 1

(a) The engine of a 1500-kg automobile has a power rating of 75 kW. Determine the time required to accelerate this car from rest to a speed of 100 km/h at full power on a level road.

(5 marks)

(b) The lighting needs of a storage room are being met by 6 fluorescent light fixtures, each fixture containing four lamps rated at 60 W each. All the lamps are on during operating hours of the facility, which are 6 AM to 6 PM 365 days a year. The storage room is actually used for an average of 3 h a day. If the price of electricity is RM0.08/kWh, determine the amount of energy and money that will be saved as a result of installing motion sensors and determine the simple payback period if the purchase price of the sensor is RM 32 and it takes 1 hour to install it at a cost of RM 40.

(15 marks)

Question 2

(a) A rigid tank contains water vapor at 250°C and an unknown pressure. When the tank is cooled to 150°C, the vapor starts condensing. Estimate the initial pressure in the tank.

(5 marks)

(b) The pressure in an automobile tiredepends on the temperature of the air in the tire. When the air temperature is 25°C, the pressure gage reads 210 kPa. If the volume of the tire is 0.025 m^3, determine the pressure rise in the tire when the air temperature in the tire rises to 50°C. Also, determine the amount of air that must be bled off to restore pressure to its original value at this temperature. Assume the atmospheric pressure is 100 kPa.

(15 marks)

Question 3

(a) Refrigerant-134a enters the compressor of a refrigeration system as saturated vapor at 0.14 MPa, and leaves as superheated vapor at 0.8 MPa and 60°C at a rate of 0.06 kg/s. Determine the rates of energy transfers by mass into and out of the compressor. Assume the kinetic and potential energies to be negligible.

(5 marks)

(b) The performance of a heat pump degrades (i.e., its COP decreases) as the temperature of the heat source decreases. This will make by using heat pumps at locations withsevere weather conditions unattractive. Consider a house that is heated and maintained at 20°C by a heat pump during the winter. What is the maximum COP for this heat pump if heat is extracted from the outdoor air at

(i) 10°C, (5 marks)

(ii) -5°C, and (5 marks)

(iii) -30°C? (5 marks)

Question 4

(a) A car engine with a power output of 110 hp has a thermal efficiency of 28 percent. Determine the rate of fuel consumption if the heating value of the fuel is 19,000 Btu/lbm.

(5 marks)

(a) During the isothermal heat rejection process of a Carnot cycle, the working fluid experiences an entropy change of -0.7 Btu/R. If the temperature of the heat sink is 95°F, determine

(a) the amount of heat transfer, (5 marks)

(b) the entropy change of the sink, and (5 marks)

(c) the total entropy change for this process. (5 marks)

Question 5

(a) Consider a thermal energy reservoir at 1500 K that can supply heat at a rate of 150,000 kJ/h. Determine the exergy of this supplied energy, by assuming an environmental temperature of 25°C.

(5 marks)

(b) A refrigerator uses refrigerant-134a as the working fluid and operates on an ideal vapor-compression refrigeration cycle between 0.12 and 0.7 MPa. The mass flow rate of the refrigerant is 0.05 kg/s. Show the cycle on a T-s diagram with respect to saturation lines. Determine :

(i) the rate of heat removal from the refrigerated space and the power input to the compressor, (5 marks)

(ii) the rate of heat rejection to the environment, and (5 marks)

(iii) the coefficient of performance. (5 marks)

Question 6

(a) An air-conditioning system operating on the reversedCarnot cycle is required to transfer heat from a house at a rateof 750 kJ/min to maintain its temperature at 24°C. If the outdoorair temperature is 35°C, determine the power required tooperate this air-conditioning system.

(5 marks)

(b) A geothermal power plant uses geothermal liquid water at 160°C at a rate of 440 kg/s as the heat source, and produces 14 MW of net power in an environment at 25°C. If 18.5 MW of exergy entering the plant with the geothermal water is destructed within the plant, determine

(i) the exergy of the geothermal water entering the plant, (5 marks)

(ii) the second-law efficiency, and (5 marks)

(iii) the exergy of the heat rejected from the plant. (5 marks)

END OF QUESTION