UNIVERSITY OF SWAZILAND
FACULTY OF SCIENCE
DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

MAIN EXAMINATION MAY 2012

TITLE OF PAPER: **THERMOFLUIDS**

COURSE CODE: **EE202**

TIME ALLOWED: **THREE (3)** HOURS

INSTRUCTIONS:

1. Answer any **four (4)** questions.
2. Each question carries 25 marks.
3. Marks for different sections are shown in the right-hand margin

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This paper contains four (4) pages including this page

Question 1

A circular block of diameter 1.6 meters is submerged in a liquid of density of 1650 kg/m^3, and it is tilted at 30^0 to the horizontal and the upper edge of block is 1.5 m from the surface of the liquid as shown in Figure 1.

(A) Determine the hydrostatic force and center of pressure from point O. (14 marks)

(B) Determine the density of the block if its thickness is 500mm and the resultant force acting perpendicular to the surface of the block is 70 kN. (11 marks)

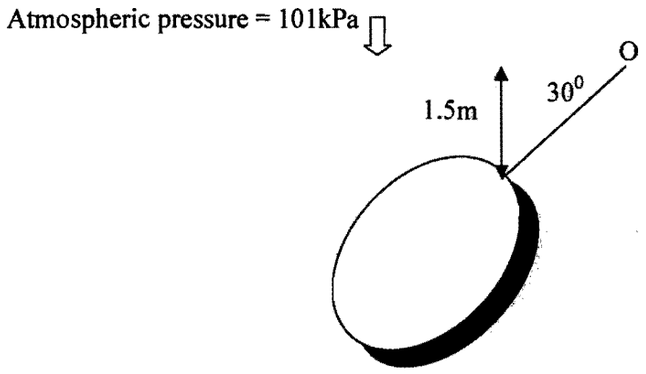

Figure 1

Question 2

(A) A car engine with power output of 50kW, when travelling at 60km/h, has a thermal efficiency of 92%. If the fuel has a heating value of 44,000kJ/kg and a density of 0.68kg/L

(I) sketch the schematic for the car engine and determine the heat transfer rate from the combustion chamber in kJ/h, and (8 marks)

(II) determine the fuel consumption rate in L/100-km of the car. (8 marks)

(B) The pilot of an airplane reads the altitude 3000m and the absolute pressure of 128 kPa when flying over a university campus. Take the density of air to be 1.2 kg/m^3.

(I) Calculate the atmospheric pressure at the campus in KPa. (5 marks)

(II) What is the altitude of the campus above level? (4 marks)

Question 3

(A) An inventor claims to have developed a refrigerator that maintains the refrigerated space at 2^0C while operating in a room where the temperature is 24^0C and that has a coefficient of performance of 13.5

(I) Draw the schematic for the refrigerator. (3 marks)

(II) Determine the maximum coefficient of performance for the refrigerator . (4 marks)

(II) Is this claim reasonable? (3 marks)

(B) For the venturi meter shown in Figure 3, if the viscous effects are negligible, the pressure and diameter at point (1) and (2) are as given in Figure 3 and the fluid is water with a density of 1000kg/m^3. Determine the volumetric flow rate Q through it. (15 marks)

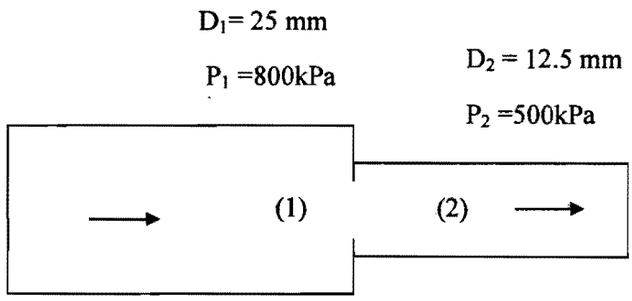

Figure 3

Question 4

The pump shown in Figure 4 adds 10kW to the water in dam1 as it pumps the water from dam 2 to dam 1 at the flow rate of 0.08 m^3/s. The density of the water is 1000kg/m^3. Determine the head loss in meters and in kW. (25 marks)

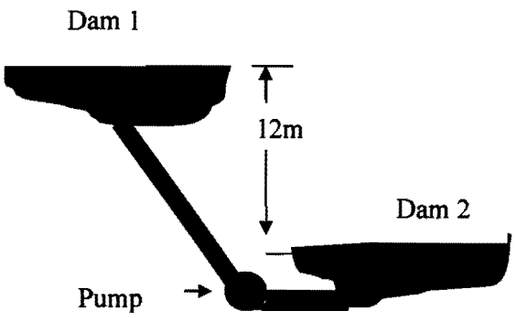

Figure 4

Question 5

Determine the anchoring force required to hold in a conical nozzle attached to the end of a laboratory sink water tap shown in Figure 5 when the water volumetric flow rate is 0.6 liter/second. The nozzle weight is 1N and the weight of the water in the nozzle at any instant is 0.03N. The nozzle inlet and exist diameters are 16mm and 5mm, respectively. The nozzle axis is vertical and the gage pressures at section (1) and (2) are 408 kPa and 0 kPa respectively. The density of the water is 1000kg/m^3. (25 marks)

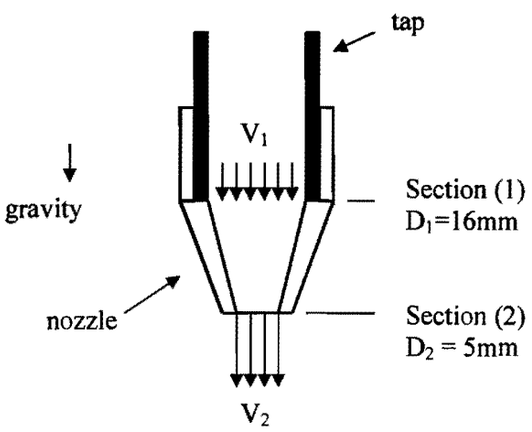

Figure 5