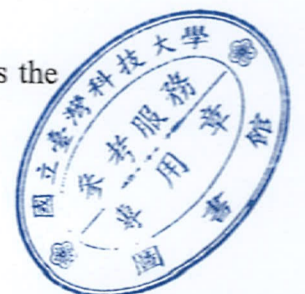國立臺灣科技大學 106 學年度碩士班招生試題

系所組別：機械工程系碩士班丙組
科　　目：熱力與流力

(總分為 100 分)

本試卷共計 7 大題

答案請以科學符號表示，計算精度取至小數點後二位。

選擇題與是非題請的答案必須書寫於答案紙內，於試題卷上作答者不予計分。

1. (10%) Multiple choices (You need to give all correct choice(s) to earn 2% for each problem, no partial credits)

   1-1. Energy can be transferred by (a) heat (b) work (c) mass

   1-2. Entropy can be transferred by (a) heat (b) work (c) mass

   1-3. Exergy can be transferred by (a) heat (b) work (c) mass

   1-4. Which of the followings are extensive properties (a) mass (b) volume (c) temperature (d) pressure (e) density

   1-5. Which of the followings are intensive properties (a) mass (b) volume (c) temperature (d) pressure (e) density

2. (10%) True or false (2% for each problem)

   2-1. There is a continuously-working refrigerator in a well-sealed and well-insulated room. Initially, the average temperature of the room is 300 K. The average temperature of the room would be lower than 300 K if the door of the refrigerator keeps open for two hours.

   2-2. For a closed system undergoing a cycle, the change in internal energy is zero, and therefore, the net work output of the system is equal to the net heat transfer to the system.

   2-3. The thermal efficiency of a heat engine is the ratio of the net work output to the total heat input. Thus, the maximum possible thermal efficiency of a Carnot heat engine is 100%.

   2-4. Transferring heat from a colder medium to a warmer one is possible as long as the device that is used to do such a transfer is driven by an external power source.

   2-5. Any process that does not produce a net entropy is reversible.
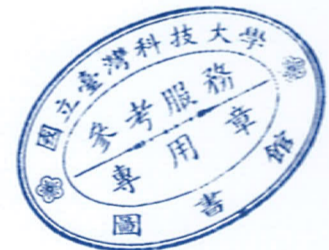
(總分為 100 分)

3. (15%) Consider a heat exchanger that is used to heat light oil by steam. Now, 2 m³/min of a light oil are to be heated from 25 °C to 95 °C by using 250 kPa steam of 80% quality. The heat losses to the surroundings are estimated to be 10% of the heat transferred from the steam to the oil. The steam leaves the heat exchanger at its saturation point. Determine the mass of the steam per hour required in this heat exchanger.

The density and the specific heat of light oil is 880 kg/m³ and 2 kJ/kg·K, respectively. The properties of steam at 250 kPa: h_f=535.35 kJ/kg, v_f=0.001067 m³/kg, h_g=2716.5 kJ/kg, and v_g=0.71873 m³/kg.

4. (15%) A well-insulated and well-sealed room is heated by a tank of hot water that is 500 kg and at 60 °C. The dimension of the room is 3 m by 5 m by 5 m and is initially at 20 °C and 100 kPa. Determine,

(a) the final equilibrium temperature of the room, and (8%)

(b) the total entropy change during this process. (7%)

The specific heats of water and air at room temperature are 4.18 kJ/kg·K and 0.718 kJ/kg·K, respectively. The gas constant of air is 0.287 kPa·m³/kg·K.
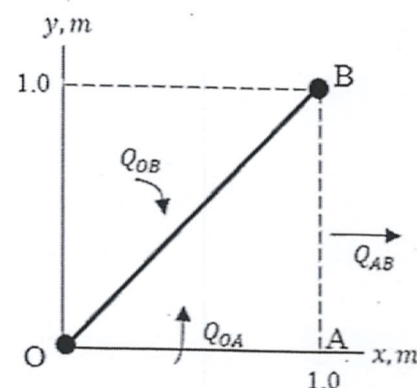
(總分為 100 分)

5. (20%) Water flows steadily through a horizontal device. At the inlet 1 the diameter is

D_1=20 cm; at the outlet 2 the diameter is D_2=10 cm. The flow rate is Q=0.02 m³/s. If the

specific gravity (S.G.) of fluid in the U-tube is 11, what is the height difference Δh in the

U-tube? Note that $\rho_{water} = 1,000$ kg/m³
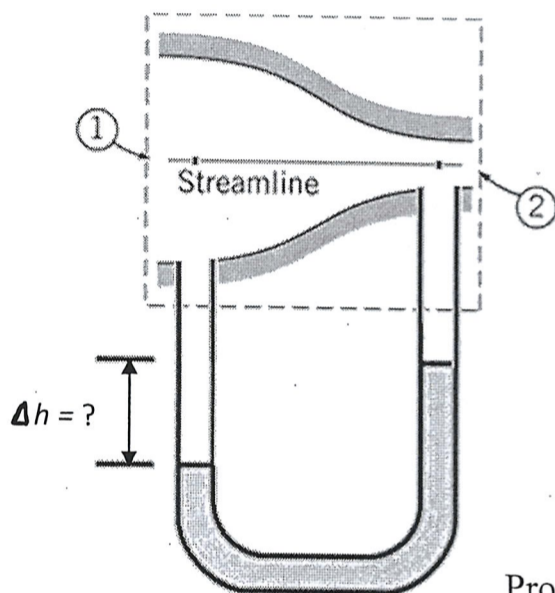
Problem 5   Problem 6

6. (20%) For a two-dimensional flow field, the x and the y velocity components are given by

$u = 3x^2 - 3y^2$ and $v = -6xy$ (unit: m/sec), respectively

(a) Is it an incompressible flow? （5%）

(b) Find the stream function for it if this is incompressible flow. （5%）

(c) Find the stream-line(s) passing through the origin. （5%）

(d) What is the volumetric flow rate of fluid crossing the surface **OB**? （5%）
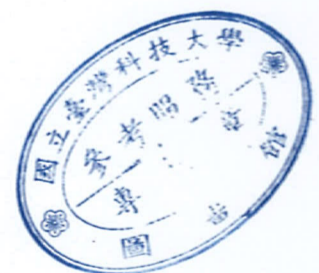
7. (10%) Experimental results show that the pressure drop for the flow through an orifice of

diameter d mounted in a fixed length of pipe of diameter D is expressed as a function with

5 independent parameters $\Delta p = p_1 - p_2 = f(\rho, \mu, V, d, D)$. Please show the dimensionless

parameters for this problem.