UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 8 Examination in Engineering: November 2014

Module Number: ME8324 **Module Name: Industrial Fluid Dynamics**

[Two Hours]

[Answer **all questions**, each question carries five marks]

Q1 a) Explain why accurate estimation of resistance to flow in different components of a particular fluid flow system is very difficult.

[1.5 Marks]

b) What are the main factors that affect the local pressure losses in pipe fittings and valves? Explain three of them.

[1.5 Marks]

c) Explain the sentence "Resistance to flow in non-circular conduits is more difficult to estimate than circular conduits". Also, with clear sketches discuss the secondary flow in non-circular ducts.

[2 Marks]

Q2 The fuel supply gallery for a small gas turbine is shown in Figure Q2. Each injection nozzle passes 6 litres of Naphtha per minute. The head loss for flow in a pipe can be written as $h_f = KQ^n$ where K is the pipe resistance and Q is the volume flow rate. The relationships between the pipe resistances are as follows,

$K_{BC}=K_{CD}=K_{AO}=K_{OE}$, $K_{AB}=K_{DE}$, $K_{AB}=2K_{BC}$, $K_{OC}=3K_{BC}$.

If the pipe OC is 2 m long, 0.01 m diameter and the friction factor f is 0.012 in the formula $h_f = \frac{4fL}{D}\frac{v^2}{2g}$. Symbols in the formula have usual notation. Find the pressure at A, B, C and D and pressure drop between O and C.

[5 Marks]

Q3 a) What are the important factors that should be considered in designing an air conditioning duct system?

[1 Mark]

b) Explain procedural steps used in Static Regain Method to estimate total pressure loss of a duct system.

[2 Marks]

c) Explain briefly why system balancing and optimization is required after laying air conditioning duct system.

[1 Mark]

d) Explain how to obtain the balance point by investigating the variation of Fan Total Pressure (FTP) and the duct performance curve for a particular fan operating speed.

[1 Mark]

Q4 a) Explain why different two-phase flow regimes require different two-phase frictional pressure drop prediction methods.

[1 Mark]

b) In a refrigeration system, a two-phase mixture of R-123 refrigerant flows upward in a vertical tube of 10 mm internal diameter that is 2 m long. The flow is adiabatic and the mass flow rate and the vapour quality are 0.02 kg/s and 0.05, respectively. The fluid R-123 is at a saturation temperature of 3°C and saturation pressure of 0.37 bar and whose physical properties are liquid density=1518 kg/m^3, vapour density=2.60 kg/m^3, liquid dynamic viscosity=0.0005856 kg/ms and vapour dynamic viscosity=0.0000126 kg/ms. Using the homogeneous flow pressure drop method, calculate the two-phase pressure drop in the tube.

[4 Marks]

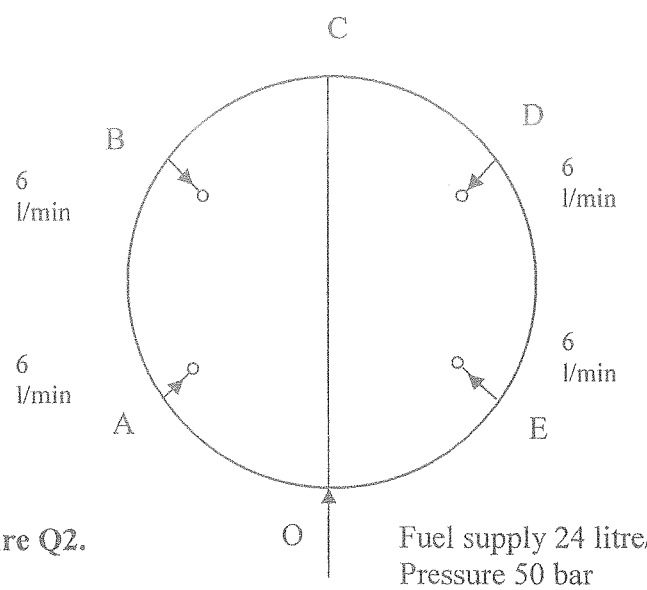

Figure Q2.