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The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	:DMX 3512 – BASIC THERMO FLUID (MEX 3212)
Academic Year	: 2017/18
Date	: 02nd, February 2019
Time	: 9.30am -12.30pm
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 8 questions. All questions carry equal marks.
3. Answer **any 5** questions only.
4. Attach the question paper to your answer script.
5. Take acceleration due to gravity and the density of water as **9.81 N/kg** and **1000 kg/m3** respectively where necessary.

Q1.

(a). Explain what is meant by renewable energy sources and state the importance of using such energy sources. — 6-marks

(b). State 3 major energy sources available in Sri Lanka. Discuss the availability and usage of solar energy compare to other energy sources in Sri Lanka. By considering the location and other environmental aspects of the country, suggest the best renewable energy source to generate electricity. Explain your answer. — 7-marks

(c). What is "gasification" ? State the series of reactions occurring in gasification. — 7-marks

Q2.

(a). What are meant by complete combustion and incomplete combustion? Explain how these combustion processes impact on environment. — 3-marks

(b). Butane(C_4H_{10}) is a highly flammable hydro-carbon gas. Write down the balance chemical equation for burning C_4H_{10} in air. — 3-marks

(c). Calculate how many grams of CO2 would be produced from one mole of butane? — 7-marks

(d). If butane is combusted with 20% excess atmospheric air having 20% Oxygen and 80% Nitrogen, determine the mass of combustion products per 1kg of butane. (Relative atomic weights: **C-12, O-16, H-1, N-14**) — 7-marks

Q3.

As shown in **Figure 3a**, a plane surface area of **A** is totally immersed in a liquid of density **ρ**. If this surface is inclined at an angle θ to the horizontal and its centroid is at a vertical depth $\mathbf{h_c}$ below the free surface.

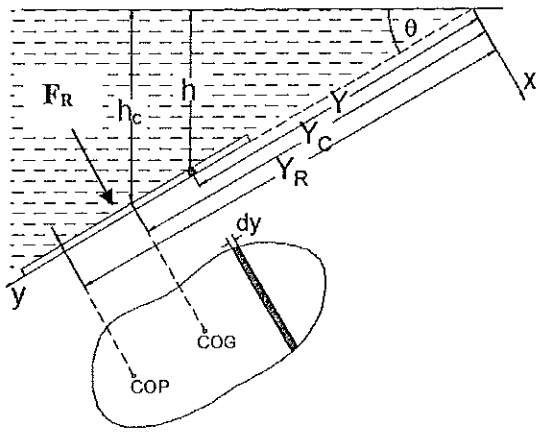


Figure 3a

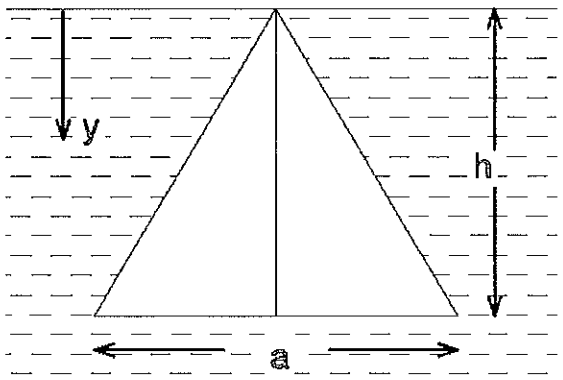


Figure 3b

(a). Derive an expression for the resultant force $\mathbf{F_R}$ on one side of the surface. *4-marks*

(b). Show that the distance to the center of pressure from the free surface is given by the expression, *6-marks*

$$y_{cp} = \frac{\int y^2 dA}{\int y dA}$$

(c). Find out the distance to the center of pressure of the triangular surface, shown in **Figure 3b**. *10-marks*

Q4.

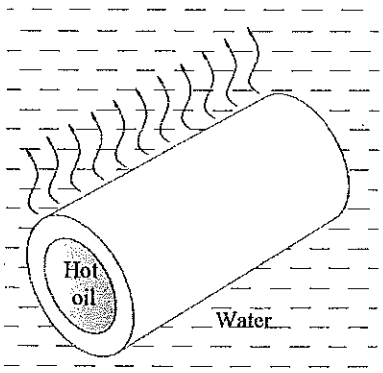
(a). Sketch the air standard cycle used to analyze the four stroke petrol engines (Otto cycle) on P-V axes and explain all process. *10-marks*

(b). Define thermal efficiency for Otto cycle and derive an expression in terms of temperatures. *10-marks*

Q5.

(a). Write down the Fourier's equation for thermal conduction and name its different terms with their SI Units of measurments. **5-marks**

(b). Carbon steel pipe is used to transfer hot oil from one machine to another. For the safety purposes, the steel pipe is immersed under water as shown in Figure 05. Determine the heat dissipation from the pipe. **15-marks**
(Mention any assumptions you made.)



Property	Value
Oil temperature	$80C^o$
Water temperature	$30C^o$
Pipe inner radius	$20cm$
Pipe outer radius	$25cm$
Conduction coefficient of Carbon steel	$36W/Km$
Convection coefficient of Oil	$100W/m^2K$
Convection coefficient of Water	$200W/m^2K$
Length of the pipe	$10m$

Figure 05

Q6.

(a). State the first law of thermodynamics. **3-marks**

(b). What is the difference between a closed system and an open system? **3-marks**

(c). A cylinder contains 1 kg of a gas at an initial pressure of 20 bar with the initial volume of 0.05 m^3 as shown in Figure 6. The gas is allowed to expand behind a piston according to the law PV^2 = constant until the volume is doubled. The gas is then cooled at constant pressure until the piston returns its original position. Heat is then supplied with the piston firmly locked in position until the pressure rises to the original value of 20 bar (1bar=10^5 N/m^2).

i). Draw a P-V diagram to describe the above processes. **7-marks**

ii).Calculate the net work done by the gas. **7-marks**

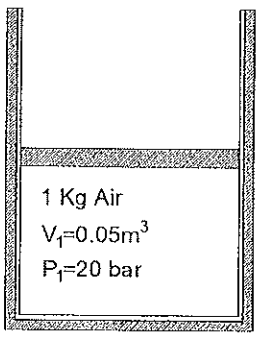


Figure 06

Q7.

a) What are meant by steady flow and uniform flow in fluids? — 4-marks

b) State Bernoulli's equations and name its different parameters. — 3-marks

c) What are the limitations in Bernoulli's equation? Explain them briefly. — 3-marks

d) By considering the pipe arrangement of ABC shown in Figure 07, calculate the pressure and the speed at section B and C. — 10-marks

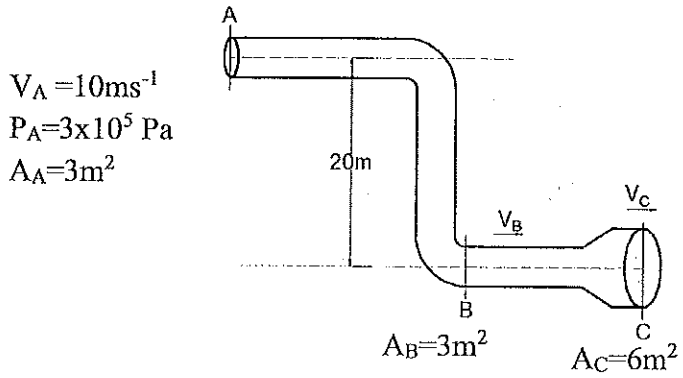


Figure 07

Q8.

a). Derive an expression for the force exerted by a jet of liquid which strikes a stationary flat plate normally. — 8-marks

b). A square plate of uniform thickness and length **30cm** hangs vertically from hinges at its top edge as shown in the **Figure 8**. When a horizontal water-jet strikes the plate at its center, the plate is deflected and comes to rest at an angle of 30^0 to the vertical. The water-jet is **20mm** in diameter and has velocity of $10ms^{-1}$. Calculate the mass of the plate and give the distance along the plate, form the hinge, of the point at which the water-jet strikes the plate in its deflection position. — 12-marks

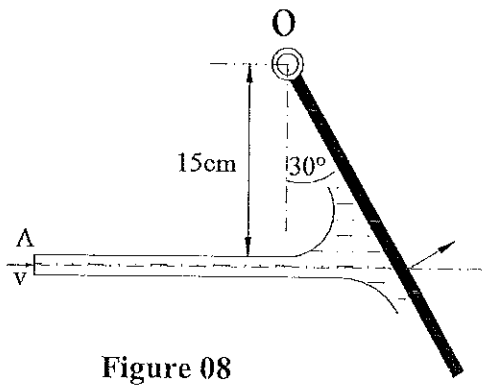


Figure 08

End of Paper