FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**April 2021**
Programme	:	Diploma in Mechanical Engineering (DMEN)
Course	:	**EGR2178: Fluid Mechanics 1**
Date of Examination	:	28 July 2021 (Wednesday)
Time	:	4.00pm – 6.15pm Reading Time : Nil
Duration	:	2 Hours 15 Minutes

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Material permitted :
Non-Programmable Scientific Calculator

Materials provided :
Nil

Examiner(s)	:	**Mohammad Faiz Osrin**
Chief Moderator	:	Iylia Elena Abdul Jamil

*This paper consists of **6** printed pages, including the cover page*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGR2178: FLUID MECHANICS 1
FINAL ALTERNATIVE ASSESSMENT: APRIL 2021 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Question 1

(a) Hydraulic turbine uses water to generate electricity. Water flows at the inlet turbine nozzles at 700 kPa absolute pressure with a low velocity. While the outlets nozzles are exposed to atmospheric pressure of 100 kPa, determine the maximum velocity to which water can be accelerated by the nozzles before striking the turbine blades.

(10 Marks)

(b) A large water bottle is placed on a table filled with drinking water. A plastic hose is inserted in the bottle and another end with on/off valve placed vertically towards a glass near the table. The diameter of the hose is 0.6 cm while the distance between glass and table is 0.6 m. If the water level in the bottle is 1.05 m when it is full, determine the duration it will take to fill 0.25L glass

i. When the bottle is first opened

(10 Marks)

ii. When bottle is almost empty

(5 Marks)

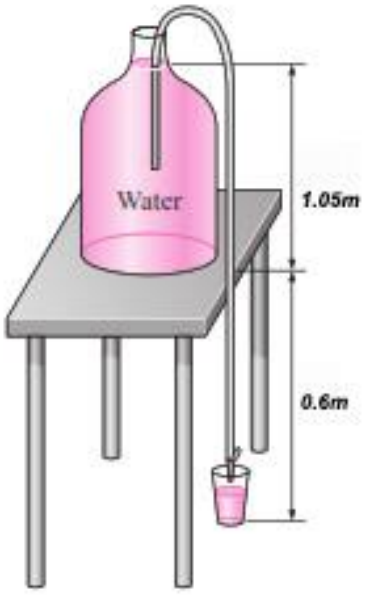


Figure Q1(b)

Question 2

(a) Volumetric strain rate is the rate of increase of volume of a fluid element per unit volume. In Cartesian coordinates, the volumetric strain rate is defined as

$$\frac{1}{V}\frac{DV}{Dt} = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z}$$

Determine the primary dimensions of each additive term, and verify that the equation is dimensionally homogeneous.

(12 Marks)

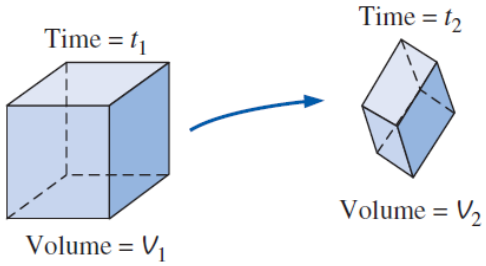


Figure Q2(a)

(b) The ventilation of a room is shown as Figure Q2(b) below. There is a source S (mass per unit area) of air pollution in the room with volume capacity V. The room include gases from cigarette and kerosene heater and vapors from an open container. The mass concentration is represent as c (mass of contaminant per unit volume of air). The differential equation for mass concentration in the room as a function of time is given by following equation

$$V\frac{dc}{dt} = S - V_c - cA_sK_w$$

K_w is an adsorption coefficient and A_s is the surface area of walls. Determine

(i) The primary dimensions of each additive term

(7 Marks)

(ii) The dimension of K_w

(6 Marks)

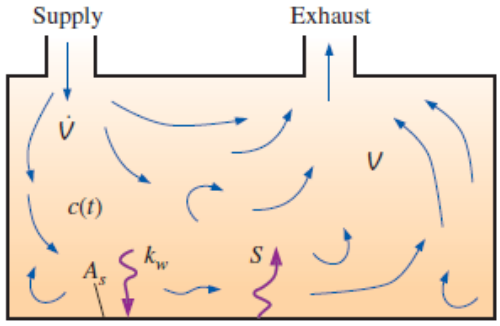


Figure Q2(b)

Question 3

(a) In a circular pipe, the flow is considered as laminar. The velocity at R/2 (midway between wall surface and the centerline) as shown in Figure Q3(a) is measured to be 15 m/s. Determine the velocity at the center of the pipe.

(9 Marks)

$$U(r) = U_{max}\,(1 - r^2/R^2)$$

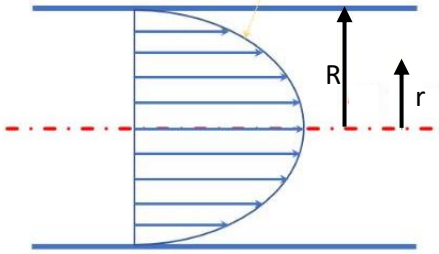


Figure Q3(a)

(b) Water is flowing steadily in a long 30 m cylinder pipe with 5 cm diameter with a flowrate of 9 L/s. The temperature of the water is at 15°C (ρ = 999.7 kg/m^3 and μ =1.138x10^{-3} kg/m·s). The relative roughness of stainless steel is ε = 0.002 mm. Determine

(i) the pressure drop

(10 Marks)

(ii) the head loss

(3Marks)

(iii) the pumping power requirement to overcome this pressure drop.

(3Marks)

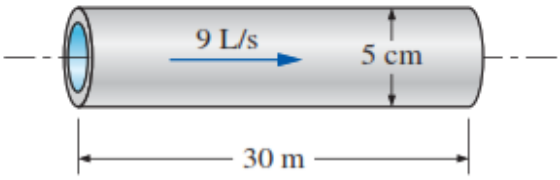


Figure Q3(b)

Question 4

(a) On a hot day, a truck moves along the highway at 30 m/s. The flat side of the truck is treated as a simple, smooth flat-plate boundary layer, to first approximation. Given, T = 30°C, ρ = 1.164 kg/m^3, $\mu = 1.872 \times 10^{-5}$ kg/ms. Determine

(i) the position along the x-direction of the plate where the boundary layer begins to transition to turbulence.

(5 Marks)

(ii) the position along the x-direction of the plate where the boundary layer undergo turbulence

(5 Marks)

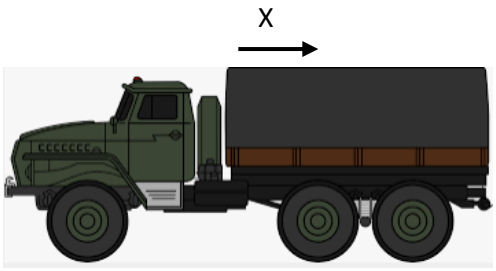


Figure Q4(a)

(b) For the small wind tunnel, Air flows through the test section of a small wind tunnel at speed V = 2.5m/s. The temperature of the air T = 20°C, kinematic viscosity, $\nu = 1.516 \times 10^{-5}$m^2/s and the length of the wind tunnel test section is 1.5 m. Determined the:

(i) type of boundary layer along the wall

(6 Marks)

(iii) the boundary layer thickness

(3 Marks)

(iv) displacement thickness,

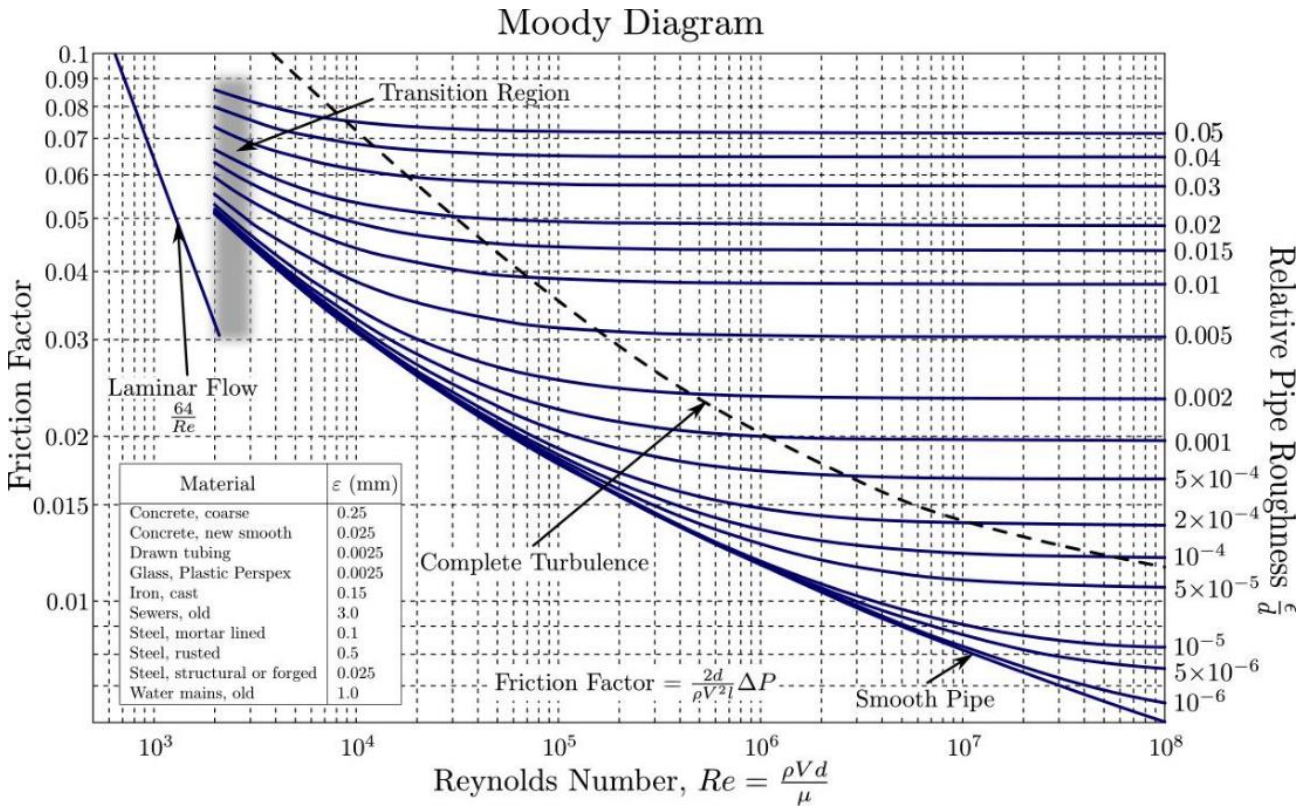
(3 Marks)

(iv) momentum thickness at the end of the test section.

(3 Marks)

~THE END~

Moody Chart



Material	ε (mm)
Concrete, coarse	0.25
Concrete, new smooth	0.025
Drawn tubing	0.0025
Glass, Plastic Perspex	0.0025
Iron, cast	0.15
Sewers, old	3.0
Steel, mortar lined	0.1
Steel, rusted	0.5
Steel, structural or forged	0.025
Water mains, old	1.0