



UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE : LMD14002

SUBJECT TITLE : FLUID MECHANICS

PROGRAMME NAME : DIPLOMA OF ENGINEERING TECHNOLOGY IN
(FOR MPU: PROGRAMME LEVEL) MARINE ENGINEERING

TIME / DURATION : 09.00 AM - 11.30 AM
(2 HOURS 30 MINUTES)

DATE : 25 JUNE 2025

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
 2. This question paper has information printed on both sides of the paper.
 3. This question paper consists of **TWO (2)** sections; Section A and Section B.
 4. Answer **ALL** question in Section A, and **TWO (2)** questions **ONLY** in Section B.
 5. Please write your answers on this answer booklet provided.
 6. Answer **ALL** questions in English language **ONLY**.
 7. Table of formulae and appendices has been appended for your reference.
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THERE ARE 11 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

**INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.**

Question 1

With reference to fluid properties and pressure:

- (a) Differentiate between density and relative density. (4 marks)
- (b) Define the following terms:
- i. Gauge pressure (2 marks)
 - ii. Atmospheric pressure (2 marks)
- (c) i. Sketch a simple diagram of barometer. (3 marks)
- ii. Explain the working principle of barometer. (4 marks)
- (d) Using appropriate example, describe Pascal Principle. (5 marks)

Question 2

With reference to Archimedes' Principle, Bernoulli's Equation and fluid head:

- (a) An 800 kg boat floats with one – third of its volume submerged in seawater. Given the density of seawater is 1025 kg/m^3 .
- i. Calculate the volume of seawater displaced by the boat. (4 marks)
 - ii. Compute the density of the boat. (5 marks)
- (b) Liquid of density 790 kg/m^3 flows through a pipe system shown in Figure 1. The diameter of the pipe at point ① is 120 mm and 100 mm at point ②. The gauge pressure at point ① is equal to 65 kPa and the velocity is 3 m/s. Calculate:
- i. the velocity at point 2 (3 marks)
 - ii. the total head at point 1 (4 marks)
 - iii. the pressure at point ② using Bernoulli Equation (neglect losses). (4 marks)

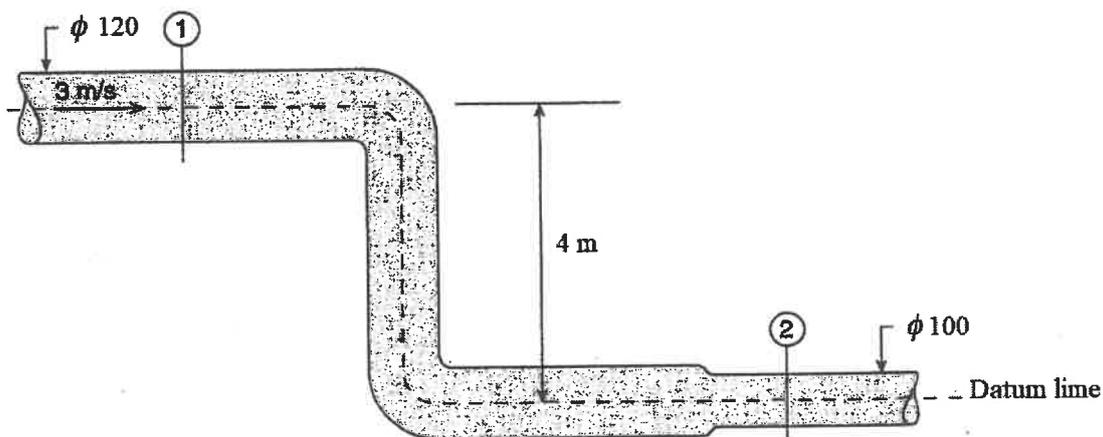


Figure 1

Question 3

With reference to fluid flow and Continuity Equation:

As shown in Figure 2, oil flows from A and B and discharges at D. The velocity at C is 1.75 m/s and its diameter is 150 mm. Given that the diameters at A and B are 80 mm and 100 mm, respectively. Calculate:

- (a) the volume flow rate at C (3 marks)
- (b) the diameter at D if the velocity is 1.6 m/s (4 marks)
- (c) the velocity at A if its volume flow rate is 40% of the total flow rate (5 marks)
- (d) the velocity at B (4 marks)
- (e) mass flow rate at B if the relative density of the oil is 0.82. (4 marks)

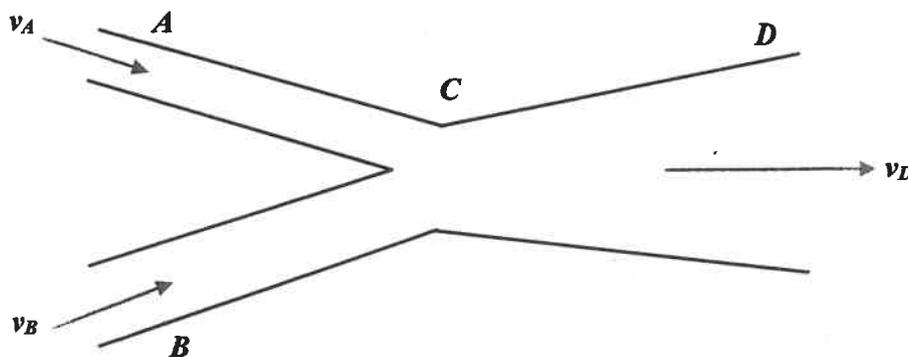


Figure 2

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO (2) questions.

Please use the answer booklet provided.

Question 4

With reference to losses in a horizontal pipe:

Diesel fuel flows at a rate of 1800 L/min through a commercial steel pipe with an internal diameter of 90 mm and a length of 110 m. The kinematic viscosity of diesel is $4.2 \times 10^{-6} \text{ m}^2/\text{s}$, and its relative density is 0.85. Determine:

- (a) the type of flow regime (8 marks)
- (b) the friction factor (6 marks)
- (c) the head loss in the pipe (3 marks)
- (d) the pressure drops due to head loss. (3 marks)

Question 5

With reference to head loss in parallel pipes:

Figure 3 shows water at 30°C flowing through a system of PVC pipes. The diameter and length of each pipe are listed below. Given that the velocity in Pipe D is 2.75 m/s.

Pipe	Diameter (mm)	Length (m)
A	250	400
B	100	200
C	150	200
D	250	500

- (a) Calculate the friction factor of Pipe D. (10 marks)
- (b) Determine the head loss through the system using an equivalent length of parallel pipes if the friction factor is assumed to be the same in all pipes. (10 marks)

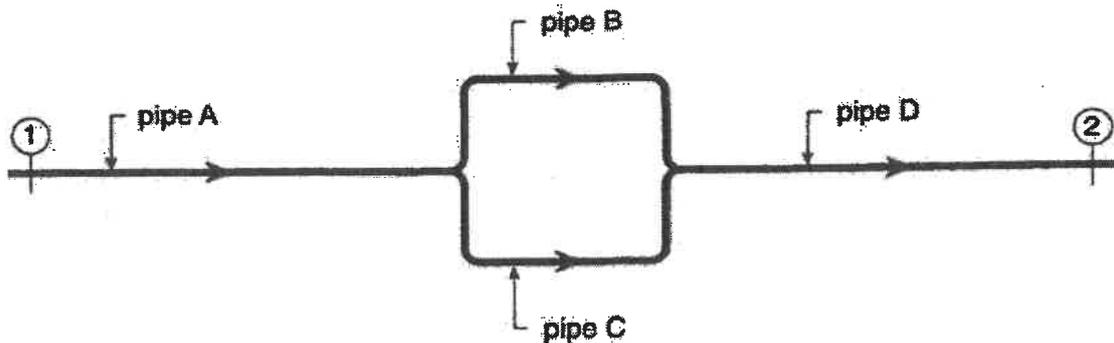


Figure 3

Question 6

With reference to fluid force:

Figure 4 shows a steam jet of 80 mm in diameter discharged from a nozzle with a velocity of 40 m/s striking a curved turbine blade and deflected at an angle of 30° . The specific volume of the steam is $1.67 \text{ m}^3/\text{kg}$. Determine:

- (a) the x-component and y-component of the force on the steam

(13 marks)

- (b) the magnitude and direction of the force on the steam.

(7 marks)

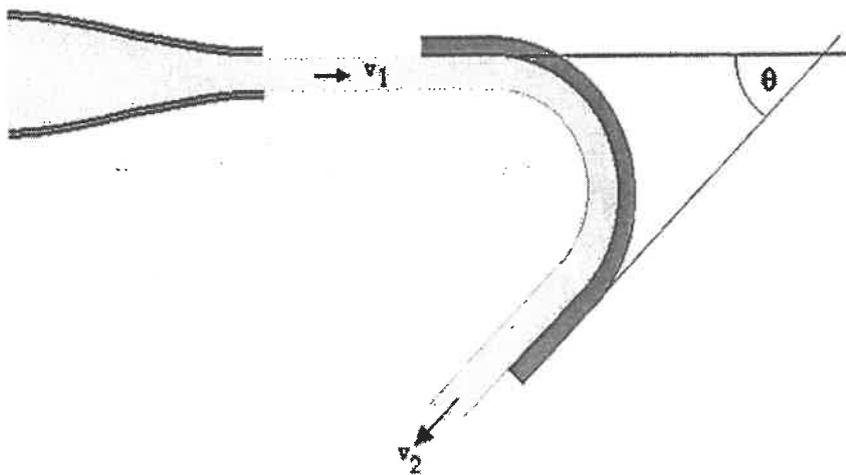


Figure 4

END OF EXAMINATION PAPER

APPENDICES

1. TABLE OF FORMULAE

$\rho = \frac{m}{V}$	$RD = \frac{\rho_{\text{substance}}}{\rho_{\text{water}}}$
$F_B = W_o$	$F_B = \rho_f V_f g$
$\dot{V} = Av$	$\dot{m} = \rho Av$
$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$	$h + \frac{P}{\rho g} + \frac{v^2}{2g} = \text{constant}$
$Re = \frac{vd}{\nu}$	$Re = \frac{\rho vd}{\mu}$
$f = \frac{64}{Re}$	$f = 0.0055 \left[1 + \left(20000 \epsilon_R + \frac{10^6}{Re} \right)^{\frac{1}{3}} \right]$
$\epsilon_R = \frac{\epsilon}{d}$	$\Delta P = \rho g H_L$
$H_L = \frac{fLv^2}{d2g}$	$H_L = \Sigma K \frac{v^2}{2g}$
$H_L = \left(\frac{fL}{d} + \Sigma K \right) \frac{v^2}{2g}$	$H_{\text{stat}} = \frac{P_2 - P_1}{\rho g} + (h_2 - h_1)$
$H_{\text{dyn}} = \frac{v_2^2 - v_1^2}{2g} + H_L$	$P_f = \dot{m}gH$
<p><i>Series pipes:</i></p> $\frac{f_E L_E}{d_E^5} = \frac{f_A L_A}{d_A^5} + \frac{f_B L_B}{d_B^5} + \dots$	<p><i>Parallel pipes:</i></p> $\left(\frac{d_E^5}{f_E L_E} \right)^{\frac{1}{2}} = \left(\frac{d_A^5}{f_A L_A} \right)^{\frac{1}{2}} + \left(\frac{d_B^5}{f_B L_B} \right)^{\frac{1}{2}} + \dots$
$\eta = \frac{P_f}{P}$	$F = \dot{m}(v_2 - v_1)$
$F_R = \sqrt{F_x^2 + F_y^2}$	$\theta = \tan^{-1} \frac{F_y}{F_x}$

2. DENSITY & DYNAMIC VISCOSITY OF WATER

Temperature (°C)	Density (kg/m ³)	Dynamic Viscosity (Pas)
0	1000	1.80×10^{-3}
5	1000	1.52×10^{-3}
10	1000	1.31×10^{-3}
15	999	1.15×10^{-3}
20	998	1.00×10^{-3}
25	997	0.90×10^{-3}
30	996	0.80×10^{-3}
35	994	0.72×10^{-3}
40	992	0.66×10^{-3}
45	990	0.60×10^{-3}
50	988	0.55×10^{-3}
55	986	0.51×10^{-3}
60	983	0.47×10^{-3}
65	980	0.44×10^{-3}
70	977	0.41×10^{-3}
75	974	0.38×10^{-3}
80	971	0.36×10^{-3}
85	968	0.34×10^{-3}
90	965	0.32×10^{-3}
95	962	0.30×10^{-3}
100	958	0.28×10^{-3}

3. K-FACTOR OF COMMON FITTING

FITTING/VALVE	CONDITION	K FACTOR
45° Elbow	Standard radius	0.3
90° Elbow	Standard radius	0.6
	Long radius	0.3
Return Bend		0.8
Socket or Coupler	Screwed type	0.03
Tee	Along line of flow	0.3
	Through side	0.8
Gate Valve	Fully open	0.2
	½ open	4.5
Globe Valve	Fully open	6.0
	¾ open	8.0
	½ open	12.0
	¼ open	24.0
Check Valve	Hinged or swing disc	1.7
	Ball or poppet type	4.0
Foot Valve with strainer	Hinged or swing disc	3.0
	Ball or poppet type	7.0
Gradual transition	Contracting	0 (negligible)
	Enlarging	0.75
Pipeline	Sudden contraction	0.25
	Sudden enlargement	1.0
Tank to pipeline	Sudden entrance	0.5
Pipeline to tank	Sudden exit	1.0

4. ABSOLUTE ROUGHNESS VALUES OF VARIOUS COMMON PIPE MATERIALS

Materials	Absolute Roughness, ϵ (mm)
Cast iron	0.25
Commercial steel/wrought iron	0.045
Galvanized iron/steel	0.15
Concrete (cast on steel forms)	0.20
Concrete (spun)	0.10
PVC and other drawn tubing	0.0015