UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMB11403**
SUBJECT TITLE	:	**FLUID MECHANICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR OF MARINE ENGINEERING TECHNOLOGY WITH HONOURS**
TIME / DURATION	:	**2.00 PM – 5.00 PM (3 HOURS)**
DATE	:	**26 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) Section; Section A and Section B.
4. Answer ALL questions in Section A. For Section B, answer THREE (3) question ONLY.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language only.
7. Answer should be written in blue or black ink except for sketching, graphic and illustration.
8. Formula has been appended for your reference.

THERE ARE 11 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

With reference to fluid flow, fluid machinery and Pascal Principle:

(a) Define laminar flow and turbulent flow.

(4 marks)

(b) Differentiate between lift and drag force.

(4 marks)

(c) Describe the following:

i. Positive displacement pump

(3 marks)

ii. Rotodynamic pump

(3 marks)

(d) Hydraulic lift works according to Pascal's Principle. Explain Pascal's Principle using hydraulic lift as an example.

(6 marks)

Question 2

With reference to fluid flow and Continuity Equation:

An oil flows through a 200 mm diameter pipe at a rate of 50 L/s. As shown in Figure 1, the pipe then split into two branches. The diameter of pipe B is 150 mm and the velocity in pipe C is 2 m/s. If the relative density of the oil is 0.88, calculate:

(a) the mass flow rate in Pipe A

(4 marks)

(b) the velocity of the oil in pipe A

(3 marks)

(c) the diameter of pipe C if the volume flow rate at C is 30% of the total flow rate

(5 marks)

(d) the volume flow rate in pipe B

(2 marks)

(e) the velocity of pipe B

(3 marks)

(f) the mass flow rate at B.

(3 marks)

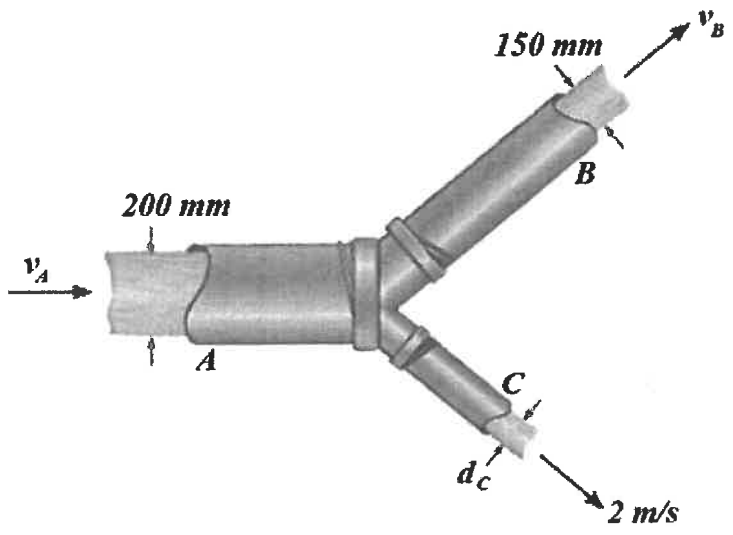

Figure 1

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.
Please use the answer booklet provided.

Question 3

With reference to drag force, fluid machinery and buoyancy:

(a) The drag coefficient of a certain underwater vehicle at the design conditions of 40 km/h is to be determined experimentally. The frontal area of the vehicle is 2.5 m^2. The force acting on the vehicle in the flow direction is measured to be 4 kN. If the relative density of seawater is 1.02, determine the drag coefficient of this underwater vehicle.

(6 marks)

(b) A rotary vane motor has a displacement volume of 80 cm^3/rev and operate at 1750 rev/min. The system pressure is 700 kPa. Calculate:

i. the theoretical flow rate

(4 marks)

ii. the power output of the motor.

(4 marks)

(c) A steel hull with a density of 7800 kg/m^3 completely immersed in seawater. A crane is used to lift the 16500 kg hull out of seawater. If the density of seawater is 1020 kg/m^3. Determine the tension in the crane's cable when the hull is submerged in seawater.

(6 marks)

Question 4

With reference to losses in horizontal pipe.

Diesel fuel is pumped at a rate of 240 L/min through a PVC pipe of diameter 150 mm and length 1 km. The relative density of the diesel is 0.83 and the kinematic viscosity of diesel is 3.2×10^{-6} m^2/s. Determine:

(a) the flow regime

(8 marks)

(b) the friction factor

(6 marks)

(c) the pressure drops due to head loss

(6 marks)

Question 5

With reference to head loss due to fittings.

A piping system in Figure 2 is used to transfer water at 20°C from the lower tank to the upper tank using a pump at a rate of 4 m/s. The diameter of the pipe is 100 mm and the total length of the piping system is 500 m. The gauge pressure at the upper tank is 80 kPa and it is 4.5 m above the surface of water in the lower tank. Given that the friction factor of the pipe is 0.039, determine:

(a) the K factors for all fitting

(7 marks)

(b) the head loss in a system

(4 marks)

(c) the system head

(4 marks)

(d) the fluid power.

(5 marks)

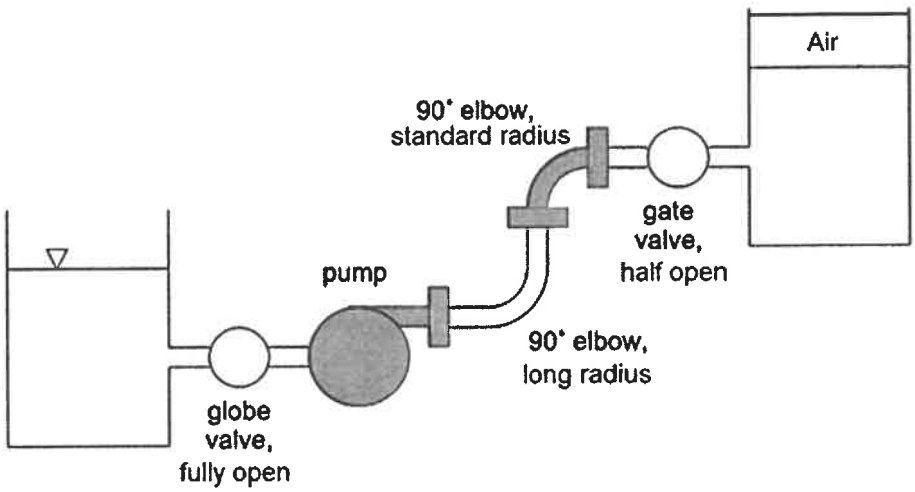

Figure 2

Question 6

With reference to fluid force:

With reference to fluid flow and head loss in a series pipe:

A pipeline is made up of three steel pipes that are connected in series, each with a different diameter and length are shown in Figure 3. The pipeline conveying liquid of relative density 0.98 from tank 1 to tank 2. Determine:

(a) the velocity of Pipe C if the velocity of water in Pipe B is 4.8 m/s

(3 marks)

(b) the rate of the fluid discharge from pipe C to tank 2 in unit liters per second.

(4 marks)

(c) the mass flow rate in pipe A

(4 marks)

(d) the total head loss of using the equivalent length method, assuming that the friction factor of all pipes is constant which is 0.024.

(9 marks)

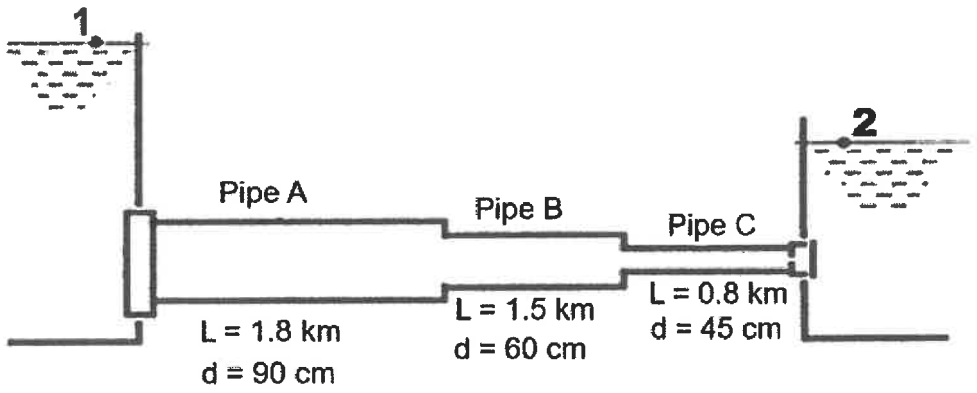

Figure 3

END OF EXAMINATION PAPER

APPENDICES

1. TABLE OF FORMULAE

$\rho = \frac{m}{V}$	$RD = \frac{\rho_{substance}}{\rho_{water}}$
$A = \frac{\pi d^2}{4}$	$\dot{V} = Av$
$\dot{m} = \rho A v$	$F_D = \frac{1}{2} C_D \rho A V^2$
$\dot{V}_T = V_D . N$	$P_{out} = P\dot{V}$
$F_B = W_o$	$F_B = \rho_f V_f g$
$Re = \frac{vd}{\nu}$	$Re = \frac{\rho v d}{\mu}$
$f = \frac{64}{Re}$	$f = 0.0055\,[1 + (20000\varepsilon_R + \frac{10^6}{Re})^{\frac{1}{3}}]$
$\varepsilon_R = \frac{\varepsilon}{d}$	$\Delta P = \rho g H_L$
$H_L = \frac{fLv^2}{d2g}$	$H_L = \Sigma K \frac{v^2}{2g}$
$H_L = \left(\frac{fL}{d} + \Sigma K\right)\frac{v^2}{2g}$	$H_{stat} = \frac{P_2 - P_1}{\rho g} + (h_2 - h_1)$
$H_{dyn} = \frac{v_2^2 - v_1^2}{2g} + H_L$	$P_f = \dot{m} g H$
Series pipes: $\frac{f_E L_E}{d_E^5} = \frac{f_A L_A}{d_A^5} + \frac{f_B L_B}{d_B^5} + \cdots$	*Parallel pipes:* $\left(\frac{d_E^5}{f_E L_E}\right)^{\frac{1}{2}} = \left(\frac{d_A^5}{f_A L_A}\right)^{\frac{1}{2}} + \left(\frac{d_B^5}{f_B L_B}\right)^{\frac{1}{2}} + \ldots$

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