SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI II : 2024/2025

DCB20313 : INTRODUCTION TO FLUID MECHANICS

TARIKH : 21 MEI 2025
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.

Subjektif (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:
This section consists of **FOUR (4)** subjective questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO1 (a) Specific Weight (γ) is one of the important properties of a fluid. Describe specific Weight.
Berat Tertentu (γ) adalah salah satu sifat penting bendalir. Huraikan Berat khusus.

[9 marks]
[*9 markah*]

CLO1 (b) Reynolds number (Re) is a fundamental concept in fluid mechanics that helps engineers classify fluid flow. Explain each term involved in Reynolds number formula.
Nombor Reynolds (Re) ialah konsep asas dalam mekanik bendalir yang membantu jurutera mengklasifikasikan aliran bendalir. Terangkan setiap sebutan yang terlibat di dalam formula nombor Reynolds.

[6 marks]
[*6 markah*]

CLO1

(c) By observing the Reynolds number, engineers can determine the type of flow and design systems accordingly, such as ensuring efficient pipe systems or optimizing aerodynamic shapes. Explain **TWO (2)** types of fluid flow.

*Dengan mengkaji nombor Reynolds, jurutera boleh menentukan jenis aliran dan sistem reka bentuk dengan sewajarnya, seperti memastikan sistem paip yang cekap atau mengoptimumkan bentuk aerodinamik. Terangkan **DUA (2)** jenis aliran bendalir.*

[10 marks]

[*10 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) In fluid mechanics, pressure is classified into absolute pressure, atmospheric pressure, and gauge pressure. Identify absolute pressure, atmospheric pressure and gauge pressure with the relationship between these three pressures.

Dalam mekanik bendalir, tekanan dikelaskan kepada tekanan mutlak, tekanan atmosfera, dan tekanan tolok. Kenal pasti tekanan mutlak, tekanan atmosfera dan tekanan tolok dengan hubungan antara ketiga-tiga tekanan.

[9 marks]

[9 *markah*]

CLO1 (b) Uniform flow is a fundamental concept in fluid mechanics, where the flow characteristics (velocity, pressure, etc.) remain consistent across any given section of the flow. This condition is essential in designing efficient fluid transport systems, such as pipes, channels, or open water systems, where smooth and predictable fluid behaviour is required. Explain **THREE (3)** conditions required for uniform flow to occur.

*Aliran seragam ialah konsep asas dalam mekanik bendalir, di mana ciri-ciri aliran (halaju, tekanan, dll.) kekal konsisten merentasi mana-mana bahagian aliran tertentu. Keadaan ini penting dalam mereka bentuk sistem pengangkutan bendalir yang cekap, seperti paip, saluran atau sistem air terbuka, di mana gelagat bendalir yang licin dan boleh diramal diperlukan. Terangkan **TIGA (3)** keadaan yang diperlukan untuk aliran seragam berlaku.*

[6 marks]

[*6 markah*]

CLO1

(c) The hydraulic radius is a crucial parameter in fluid mechanics, particularly for analysing open channel flow. It helps assess the efficiency of a channel in transporting water and is vital in the design and optimization of channels for applications such as flood management and irrigation systems. Given a rectangular concrete channel with a width of 5 m and a height of 2 m, where the water depth is 2.5 m and the flow rate is 20 m^3/s, determine the hydraulic radius of the channel.

Jejari hidraulik adalah parameter penting dalam mekanik bendalir, terutamanya untuk menganalisis aliran saluran terbuka. Ia membantu menilai kecekapan saluran dalam mengangkut air dan penting dalam reka bentuk dan pengoptimuman saluran untuk aplikasi seperti pengurusan banjir dan sistem pengairan. Diberi saluran konkrit segi empat tepat dengan lebar 5 m dan ketinggian 2 m, di mana kedalaman air ialah 2.5 m dan kadar alir ialah 20 m^3/s, tentukan jejari hidraulik saluran itu.

[10 marks]

[*10 markah*]

QUESTION 3

SOALAN 3

CLO2 (a) The manning's equation is an empirical equation that applies to uniform flow in open channels and is a function of the channel velocity, flow area and channel slope. For that, estimate the slope of a circular sewer pipe which carries a discharge of 0.1 m^3/s when flowing half full. Take the value of manning's n = 0.013. Given area of flow 0.098 m^2 and wetted perimeter 0.7855 m.

Persamaan manning ialah persamaan empirikal yang digunakan untuk aliran seragam dalam saluran terbuka dan merupakan fungsi halaju saluran, kawasan aliran dan cerun saluran. Untuk itu, anggarkan kecerunan paip pembetung bulat yang membawa luahan 0.1 m^3/s apabila mengalir separuh penuh. Ambil nilai n manning = 0.013. Diberi luas aliran 0.098 m^2 dan perimeter basah 0.7855 m.

[9 marks]

[*9 markah*]

CLO2 (b) A fluid with a mass of 7500 kg filled a rectangular. The container has a length of 110 cm, width of 80 cm and height of 150 cm. Calculate the specific gravity of the fluid.

Bendalir berjisim 7500 kg memenuhi sebuah segi empat tepat. Bekas itu mempunyai panjang 110 cm, lebar 80 cm dan tinggi 150 cm. Kira graviti tentu bendalir itu.

[6 marks]

[*6 markah*]

CLO2 (c) Sudden enlargement in the diameter of pipe results in the formation of eddies in the flow of at the corners of the enlarged pipe. Calculate the head loss due to sudden enlargement of the pipe if the diameter changes from 155 mm to 170 mm. Given the flow rate of water through the pipe is 0.055 m^3/s.

Pembesaran secara tiba-tiba dalam diameter paip mengakibatkan pembentukan pusaran dalam aliran di sudut-sudut paip yang diperbesarkan. Kira kehilangan kepala akibat pembesaran mendadak paip jika diameter berubah dari 155 mm kepada 170 mm. Diberi kadar aliran air melalui paip ialah 0.055 m^3/s.

[10 marks]

[*10 markah*]

QUESTION 4

SOALAN 4

CLO2 (a) A differential connected at the two pipe A and B at the same level in a pipe containing an oil of specific gravity 0.8, shows a difference in mercury levels as 100 mm. Based on Figure 4(a), express the difference in pressure at the two pipes. *Satu pembeza yang disambungkan pada dua paip A dan B pada aras yang sama dalam paip yang mengandungi minyak graviti tentu 0.8, menunjukkan perbezaan paras merkuri sebanyak 100 mm. Berdasarkan Rajah 4(a), tentukan perbezaan tekanan pada kedua-dua paip*.

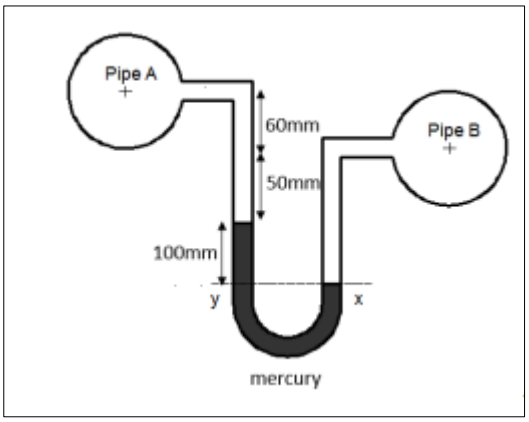

Figure 4(a) / *Rajah 4(a)*

[9 marks]

[*9 markah*]

CLO2 (b) This problem demonstrates how fluid velocity changes when the pipe diameter varies. According to the principle of continuity, the flow rate remains constant in a steady, incompressible flow. Using the principle of continuity, determine how the velocity of water flowing through a pipe at section 2 changes when the pipe diameters at sections 1 and 2 are different. Given that the velocity of water at section 1 is 10 m/s, the diameter at section 1 is 300 mm, and the diameter at section 2 is 400 mm.

Masalah ini menunjukkan bagaimana halaju bendalir berubah apabila diameter paip berubah. Mengikut prinsip kesinambungan, kadar aliran kekal malar dalam aliran yang stabil dan tidak boleh mampat. Dengan menggunakan prinsip kesinambungan, tentukan bagaimana halaju air yang mengalir melalui paip di bahagian 2 berubah apabila diameter paip di bahagian 1 dan 2 berbeza. Diberi halaju air di bahagian 1 ialah 10 m/s, diameter di bahagian 1 ialah 300 mm, dan diameter di bahagian 2 ialah 400 mm.

[6 marks]

[*6 markah*]

CLO2 (c) A Venturi meter relies on the Venturi effect to measure fluid flow by detecting pressure differences between a wider pipe section and a narrowed throat. This principle is commonly applied in industrial settings and water distribution systems to accurately calculate flow rates. In this case, a horizontal Venturi meter with diameters of 300 mm at the inlet and 150 mm at the throat is used to measure the flow of water. The differential gauge reading between the inlet and the throat is 180 mm of mercury. Calculate the flow rate through the Venturi meter, with a coefficient of discharge (Cd = 0.85).

Meter Venturi bergantung pada kesan Venturi untuk mengukur aliran bendalir dengan mengesan perbezaan tekanan antara bahagian paip yang lebih luas dan tekak yang sempit. Prinsip ini biasanya digunakan dalam tetapan industri dan sistem pengagihan air untuk mengira kadar aliran dengan tepat. Dalam kes ini, meter Venturi mendatar dengan diameter 300 mm di salur masuk dan 150 mm di kerongkong digunakan untuk mengukur aliran air. Bacaan tolok pembezaan antara salur masuk dan tekak ialah 180 mm merkuri. Kira kadar aliran melalui meter Venturi, dengan pekali nyahcas (Cd = 0.85).

[10 marks]

[*10 markah*]

SOALAN TAMAT

FORMULA

Fluid Characteristics

$$\omega = \rho g = \frac{W}{V}$$

$$S = \frac{\omega_{fluid}}{\omega_{water}} = \frac{\rho_{fluid}}{\rho_{water}}$$

$$\mu = \frac{{}^{F}/_{A}}{{}^{v}/_{h}}$$

$$\upsilon = \frac{\mu}{\rho}$$

Fluid Pressure

$$P = \frac{F}{A} = \rho\, g\, h$$

$$P_{Left} = P_{Right}$$

Flow of Fluid and Bernoulli's Equation

$$Q_{in} = Q_{out} \;\; or \;\; Q_1 = Q_2$$

$$Q = AV \;\; or \;\; A_1 V_1 = A_2 V_2$$

$$z_1 + \frac{{v_1}^2}{2g} + \frac{P_1}{\omega} = z_2 + \frac{{v_2}^2}{2g} + \frac{P_2}{\omega}$$

$$Q_{act} = C_d \times \frac{A_1 A_2}{\sqrt{{A_1}^2 - {A_2}^2}} \sqrt{2\, g\, h}$$

$$h = \frac{(\rho' - \rho)}{\rho}\, y$$

$$h = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega}\right) + (z_1 - z_2)$$

$$h = y\left(\frac{S_m}{S} - 1\right) \; if \; S_m > S$$

$$h = y\left(1 - \frac{S_m}{S}\right) \; if \; S_m < S$$

$$c_v = \frac{v}{v} = \frac{v}{\sqrt{2\, g\, h}}$$

$$c_c = \frac{a_c}{a}$$

$$c_d = \frac{Q_a}{Q_t} = \frac{Q_a}{a\sqrt{2\, g\, h}} \;\; or \; c_d = c_v \times c_c$$

Reynold's Number and Energy Losses in Pipes

$$R_e = \frac{\rho\, d\, v}{\mu} = \frac{v\, d}{\upsilon}$$

$$z_1 + \frac{{v_1}^2}{2g} + \frac{P_1}{\omega} = z_2 + \frac{{v_2}^2}{2g} + \frac{P_2}{\omega} + h_f$$

$$P_1 - P_2 = \frac{32\, \mu\, L\, v}{d^2}$$

$$h_f = \frac{4\, f\, L\, v^2}{2\, g\, d} = \frac{f\, L\, Q^2}{3\, d^5}$$

$$f = \frac{16}{Re} \;\; or \;\; \frac{0.079}{{Re}^{1/4}}$$

$$h_L = K\frac{v^2}{2g} \;\; or \;\; \frac{v^2}{2g} \;\; or \;\; 0.5\frac{v^2}{2g}$$

$$h_c = \left(\frac{1}{C_c} - 1\right)^2 \frac{{v_2}^2}{2g}$$

$$h_e = \frac{(v_1 - v_2)^2}{2g}$$

$$\frac{P_1}{\omega} + \frac{v_1}{2g} + z_1 = \frac{P_2}{\omega} + \frac{v_2}{2g} + z_2 + main\ energy\ loss + minor\ energy\ loss$$

Uniform Flow in Open Channel

$R_h = \frac{A}{P}$

$A = b\,y$

$P = b + 2\,y$

$A = (b + z\,y)\,y$

$P = b + 2\,y\sqrt{1 + z^2}$

$A = r^2\,(\theta - \sin\theta\cos\theta)$

$P = 2\,r\,\theta$

$A = (y\,tan\,\theta)\,y$

$P = 2\left(\frac{y}{\cos\theta}\right)$

$Q = \frac{A\,s^{1/2}\,R_h^{2/3}}{n}$