UTHM
Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2016/2017

TERBUKA

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|---|---|---|
| COURSE NAME | : | FLUID MECHANICS |
| COURSE CODE | : | BNP10303 |
| PROGRAMME CODE | : | BNB |
| EXAMINATION DATE | : | DECEMBER 2016 / JANUARY 2017 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWERS **FIVE (5)** QUESTIONS ONLY |

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

**Q1** (a) Define specific weight $\gamma$ of any fluid.

(3 marks)

(b) Relate dynamic viscosity $\mu$ of a fluid to its kinematic viscosity $\nu$ and give the appropriate unit.

(7 marks)

(c) Cooking oil of $SG_{oil} = 0.85$ is sold in 1 kg plastic bag packaging cost RM 2.50. Mineral water packed in 500 ml bottle is sold at RM 1.00 per bottle. Calculate the cost per kg for both items and give your opinion which more expensive. (Given: $SG_{water} = 1.0$, 1000 ml= 1 liter, 1000 liter = 1 $m^3$ )

(10 marks)

**Q2** (a) Define pressure and list down the unit commonly used.

(5 marks)

(b) Explain the difference between absolute pressure and vacuum pressure with a sketch.

(5 marks)

(c) A pressure gauge on land reading is 2050 mbar. Calculate:

(i) The gauge pressure in kPa if the atmospheric pressure then is 1.035 bar.

(ii) The gauge pressure in mbar if pressure gauge is submerged 150 m into the sea.

(Given: 1 bar = $10^5$ $N/m^2$ )

(10 marks)

**Q3** (a) Name the **TWO (2)** other types of pressure measuring devices beside a U manometer.

(5 marks)

(b) Pressure in a round closed pressurised vessel is measured using a glass U tube is unknown. The specific weight of the fluid A in the vessel is 17,167 $N/m^2$. A fluid B which is heavier than fluid A is required in the U tube manometer. If the allowed column height in the tube with fluid B is 32 cm and height in the tube with fluid B is 21 cm from the centre of the vessel, calculate the pressure in the vessel in kPa if the density of B is 39,343 kg/m3 when the atmospheric pressure is 101.3 kPa.

(8 marks)

(c) A coastal vertical retaining wall is constructed on a beach to prevent coastal erosion. The height of the vertical wall is 2.75 m and the highest sea tide level is 2.45 m deep. Calculate the maximum and average pressure exerted on the wall.

(7 marks)

**Q4** (a) Define Archimedes Law.

(5 marks)

(b) During a tsunami a 2500 kg car is seen floating in the water. If the sea water has a density of 1025 $kg/m^3$, determine the size of the car in $m^3$.

(7 marks)

(c) To test the SG of an unknown fluid X, a 500 ml plastic bottle with a known weight 4.9 N is used. When the bottle is placed inside the fluid X, three quarter (75%) of the bottle submerged below the surface of fluid X. Determine the SG of fluid X.

(8 marks)

**Q5** (a) Define continuity equation for flow in a pipeline.

(5 marks)

(b) Sketch the velocity profile of a real fluid flowing in a pipe.

(5 marks)

(c) A 10 cm diameter PVC pipe, conveying a flow of oil with flowrate Q = 0.012 $m^3/s$, is branched out into two smaller diameter PE outflow pipes. If the velocity of flow in one outflow pipe is three time faster then the other and the cross sectional of the outflow is twice smaller, calculate the inflow pipe flow velocity and outflow pipes diameters.

(10 marks)

**Q6** (a) Define Energy Grade Line (EGL).

(5 marks)

(b) Write the Bernoulli Equations equating energy at upstream and downstream for flow in a pipeline.

(5 marks)

(c) Water is pumped from a large open underground tank 2 m below the ground level with a 50 mm diameter suction pipe. The pump is rated at 500 liters per minute and the atmospheric pressure at 101.3 kPa. The water is then delivered into an overhead water tank 7 m above the ground through a 50 mm diameter pipe.

(i) Taking the water surface level as the datum what is the initial energy level?

(ii) Calculate head losses in the pipe $h_f$ if friction losses is 1 mm per 1000 m.

(iii) Total head loss constant k due to entrance, pump and exit is 0.08. Calculate the water pressure in the pipe 1 m below the overhead tank.

(10 marks)

**Q7** (a) Define mass flowrate and show its relation to volumetric flowrate.

(5 marks)

(b) A real incompressible fluid X of SG 2.6 flows in a short conical pipe with 25 mm diameter at the entry end of pipe and exit at the 10 mm diameter end of the pipe flowing at 430 liter per minute. Calculate the force $F_x$ acted on this fluid if the pressure at inlet is 200 kPa.

(7 marks)

(c) Cooking plastic bag packaging plant can pack 10,000 bags of 1 kg plastic bag in and 8 hours shift. The density of this cooking oil 800 kg/m3 and it is flowing from a storage tank to the automatic packaging machine. Calculate the following:

(i) The size of the storage tank.

(ii) The mass flow rate feeding the packaging machine.

(iii) The flow rate for a pump needed to transfer the cooking oil to packaging machine

(8 marks)

**Q8** (a) List down the type of flow in a pipe in relation to the Reynold Number.

(5 marks)

(b) Sketch the velocity profiles of a turbulent flow in comparison to a laminar flow in a pipe.

(5 marks)

(c) Oil SG = 0.85 and kinematic viscosity $v = 1.8 \times 10^{-5} m^2/s$ flows through a 100 mm diameter pipe at 0.50 L/s in a laminar fashion, Reynold Number Re = 354 < 2000. To save cost the refinery decided to install a smaller size pipe and tolerate turbulent flow. Calculate the smallest possible diameter for the pipe by trial and error method.

(10 marks)

**Q9** (a) Name the **THREE (3)** fundamental quantities.

(5 marks)

(b) What are the quantities for these dimensions $LT^{-1}$, $L^3T^{-1}$, $ML^{-3}$, $MLT^{-2}$, $L^3$

(7 marks)

(c) A 1.0 m diameter pipe carrying kerosene SG= 0.82 at a velocity 3.8 m/s is to be modelled for dynamic similarity by 10 cm diameter of water pipe, what would be the velocity of water in the model? (Given: kinematic viscosity for kerosene $v = 2.71 \times 10^{-5} m^2/s$ and for water kinematic viscosity $v = 0.801 \times 10^{-5} m^2/s$).

(8 marks)

**-END OF QUESTIONS-**

## FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2016/2017 PROGRAMME : BNB
COURSE NAME : FLUID MECHANICS COURSE CODE: BNP 10303

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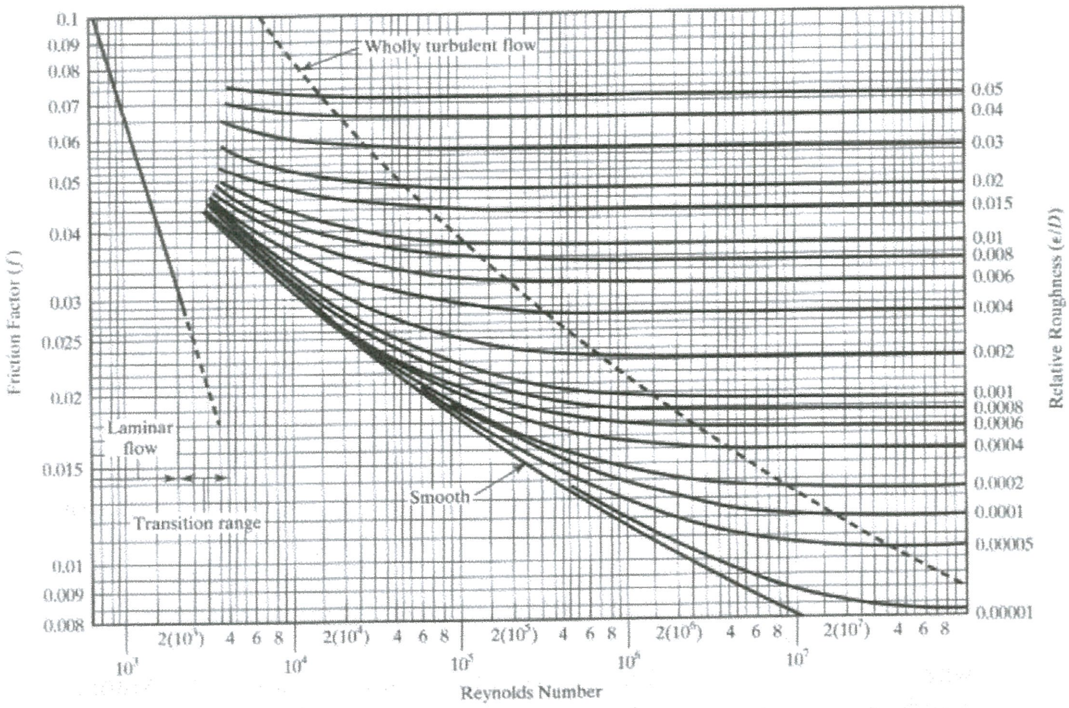
|---|---|---|
| $A_1 = C A_2^a A_3^b A_4^c .....A_n$ | $\varepsilon = \frac{e}{D}$ | $Q = Av$ |
| $\text{Re} = \frac{\rho u D}{\mu} = \frac{VD}{\upsilon}$ | $h_f = f \frac{L}{D}\frac{v^2}{2g}$ | $f = \frac{64}{R_e}$ |
| $\tau = \mu \frac{dv}{dy}$ | $Q = \frac{\dot{m}}{\rho}$ | $h_m = k\frac{v^2}{2g}$ |
| $\dot{m} = \rho Q$ | $A_1 V_1 = A_2 V_2 = Q$ | $Q_1 = Q_2 + Q_3$ |
| $\frac{P_1}{\rho g} + \frac{v_1^2}{2g} + z_1$ | $F = \rho Q (v_2 - v_1)$ | $P_{gauge} = \rho g h$ |
| $W = \rho g V$ | $\rho = \frac{m}{V}$ | $\frac{V}{m} = \frac{1}{\rho}$ |
| $\nu = \frac{\mu}{\rho}$ | $\sigma_s = \frac{F}{2b}$ | $W = mg = \rho g(\pi R^2 h)$ |

**Table of Equations**




Moody diagram of Darcy-Weisbach friction factors.