UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER I
SESSI 2011/2012

NAMA KURSUS	:	MEKANIK BENDALIR II
KOD KURSUS	:	BDA 30203/ BDA 3023
PROGRAM	:	3 BDD
TARIKH PEPERIKSAAN	:	JANUARI 2012
JANGKA MASA	:	3 JAM
ARAHAN	:	JAWAB EMPAT (4) SOALAN DARIPADA LIMA (5)SOALAN.

KERTAS PEPERIKSAAN INI MENGANDUNGI LIMA (5) MUKASURAT

Q1 a) (i) In a pipe flow, what are the differences between uniform velocity and uniform velocity profile?

(ii) Using appropriate sketches show where each of them occur.

(iii) Provide physical explanations on both phenomena above.

(10 marks)

b) A 80 percent efficient pump delivers water at 20°C (ρ = 998.2 kg/m^3 and μ = 1.002 x 10^{-3} Ns/m$^{2)}$ from one reservoir to another at 6 m higher. The piping system consists of 15 m of galvanized-iron 5-cm diameter pipe (ε = 0.15 mm), a reentrant entrance (K_L = 1.0), two screwed 90° long-radius elbows ((K_L = 0.41 each), and a screwed-open gate valve (K_L = 0.16). What is the input power required in with a 6° well-designed conical expansion (K_L = 0.3) added to the exit? The flow rate is 0.02 m^3/s.

(15 marks)

Q2 a) Derive the two-dimensional (2D) continuity equation (conservation of mass) from a differential element of side lengths δx and δy.

(10 marks)

b) In a two-dimensional incompressible flow the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$.

(i) Show that the flow satisfies the continuity equation.

(ii) Obtain the expression for the stream function.

(iii) Obtain the expression for the velocity potential.

(iv) Show that the flow is potential.

(15 marks)

Q3 a) Explain briefly the following terms:

i) laminar boundary layer;

ii) turbulent boundary layer;

iii) friction drag; and

iv) pressure drag.

(10 marks)

b) Air is flowing over a flat plate of *5 m* long and *2.5 m* wide with a velocity of *4 m/s*. If air density, $\rho = 1.208\ kg/m^3$ and kinematic viscosity, $v = 1.47 \times 10^{-5}\ m^2/s$, determine:

i) length of plate over which the boundary layer is laminar, and thickness of the boundary layer;

ii) shear stress at the location where boundary layer ceases to be laminar; and

iii) total drag force on both sides on that portion of plate where boundary layer is laminar.

(15 marks)

Q4 a) i) Differentiate between compressible and incompressible flows.

ii) How is a shock wave produced in a compressible fluid? Explain briefly two (2) types of shock wave.

(10 marks)

b) i) Air has a velocity of *1000 km/h* at a pressure of $9.81\ kN/m^2$ vacuum and a temperature of 47^oC. Determine its stagnation properties and the local Mach number. Take atmospheric pressure, $p = 98.1\ kN/m^2$, $R = 287\ J/kgK$ and $\gamma = 1.40$.

ii) What would be the compressibility correction factor for a pitot-static tube to measure the velocity at a Mach number of *0.80*.

(15 marks)

Q5 a) **Prove that the hydraulic effeciency for Pelton wheel can be shown as a function of ratio of bucket velocity over jet velocity ($\phi = U/V_1$) and reflection jet angle β.**

$$\eta_h = 2\phi\,(1 - \phi)(1 + \cos\beta)$$

Also, show that the maximum hydraulic effeciency, η_h occurred at $\phi = 0.5$.

(10 marks)

b) **A radial flow turbine operating at 600 rpm has a rotor of diameter 0.40 m and height at its periphery of 30 mm. the guide vanes are inclined at their inner edge at 42° to the tangent to the rotor circumference. If the flow rate of water through the turbine is 0.5 m^3/s, determine:**

i) **the velocity of the water as it leaves the guide vanes;**
ii) **the ideal rotor blade inlet angle; and**
iii) **the power developed by the turbine.**

Assume the fluid velocity at the rotor exit is radial.

(15 marks)

FINAL EXAMINATION

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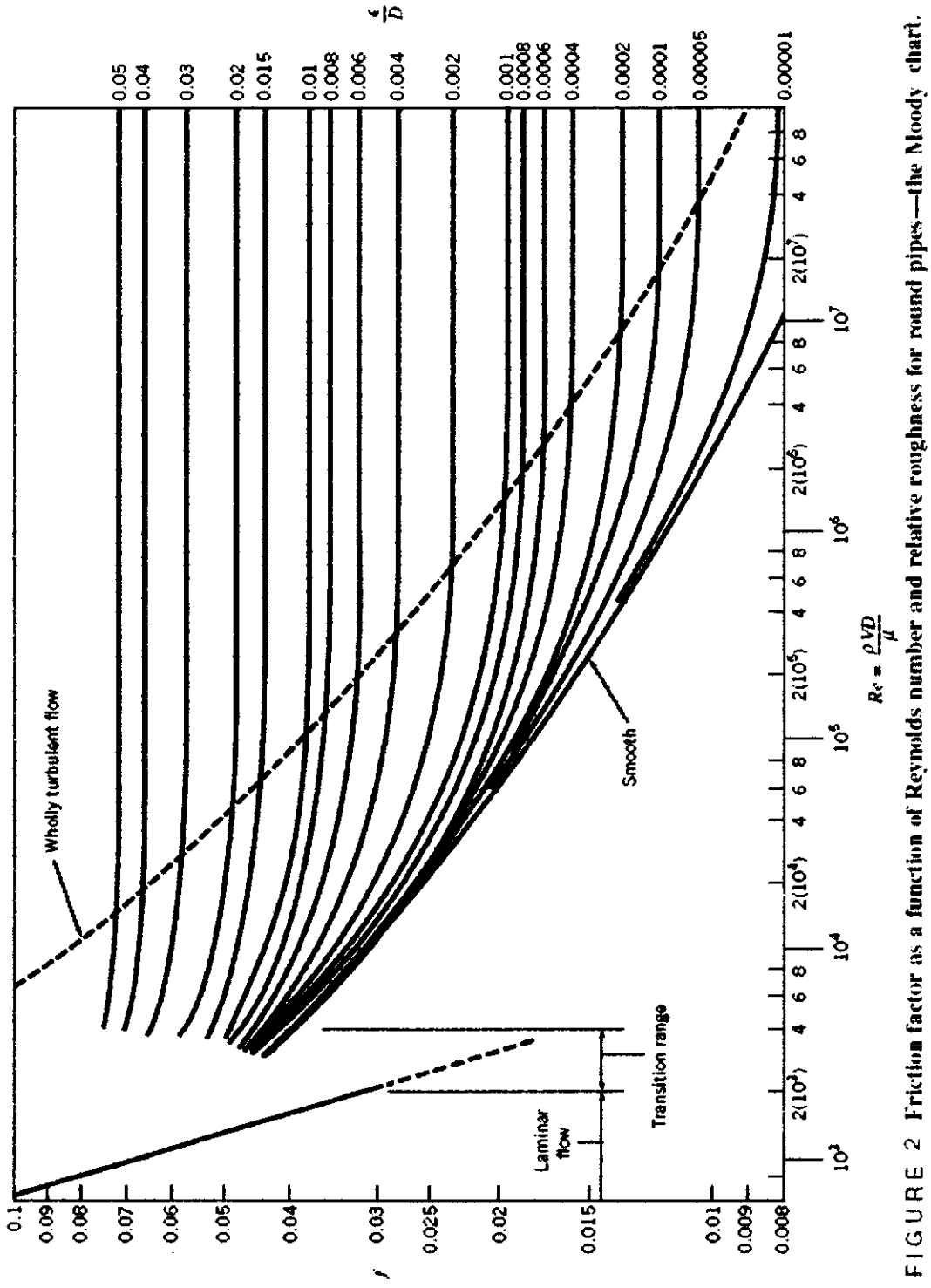

FIGURE 2 Friction factor as a function of Reynolds number and relative roughness for round pipes—the Moody chart.

FIGURE Q1