UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER I
SESI 2010/2011

NAMA KURSUS	:	MEKANIK BENDALIR II
KOD KURSUS	:	BDA 3023
PROGRAM	:	3 BDD
TARIKH PEPERIKSAAN	:	NOVEMBER/DISEMBER 2010
JANGKA MASA	:	3 JAM
ARAHAN	:	JAWAB EMPAT (4) SOALAN SAHAJA DARIPADA LIMA (5) SOALAN.

KERTAS SOALAN INI MENGANDUNGI LIMA (5) MUKA SURAT

Q1 Fully developed laminar flow in pipe is one example of fluid flow problems that can be solved by theoretical analysis.

a) For this particular case, and by neglecting the effect of the gravitational force, derive the equation for velocity profile, *u(r)*, in terms of wall shear stress, τ_ω, viscosity, μ, and pipe radius, *R*.

(10 marks)

b) When water at 20°C ($\rho = 998$ kg/m^3, $\mu = 0.001$ kg/ms) flows through an 8 cm diameter pipe, the wall shear stress is 72 Pa. Calculate :

i) volume flowrate

ii) velocity at the center

(15 marks)

Q2 a) Based on **Figure Q2(a)**, derive the mathematical expression of rotation, ω, for 2-dimensional fluid flow.

(10 marks)

b) Consider the 2-dimensional flow field in which $u = Axy$ and $v = By^2$, where $A = 1$ m^{-1}.s^{-1}, $B = -0.5$ m^{-1}.s^{-1}, and the coordinates are measured in meters.

i) Show that the velocity field represents a possible incompressible flow.

ii) Determine the rotation at point $(x,y) = (1,1)$.

iii) Evaluate the circulation about the 'curve' bounded by $y = 0$, $x = 1$, $y = 1$, and $x = 0$.

(15 marks)

Q3 a) Sketch flows past three circular cylinders of diameter D, with Reynolds Number, Re = 0.1, 10, and 10^7. Explain the characteristics of boundary layer and wake development for each case.

(15 marks)

b) A smooth, flat plate of length L = 6 m and width b = 4 m is placed in water with an upstream velocity of U = 0.5 m/s. (Take for water, ρ = 998.2 kg/m^3 and μ = 1.002 x 10-3 N.s/m$^{2)}$. Determine:

i) boundary layer thickness at the center of the plate; and

ii) shear stress at the center of the plate.

(10 marks)

Q4 a) i) Explain briefly what is Mach number and why is this parameter so important for the study of flow compresible fluids ?

ii) What is stagnation point of an object immersed in fluid ?

(12 marks)

b) An aeroplane is flying at 1000 km/h through still air having a pressure of 78.5 kN/m^2 (absolute) and temperature -8^{o}C (negative). Calculate on the stagnation point on the nose of the plane :

i) stagnation pressure

ii) stagnation temperature

iii) stagnation density

Take for air, R = 287 J/kgK and γ = 1.40.

(13 marks)

Q5 a) List the main component parts of a centrifugal pump and explain then briefly.

(10 marks)

b) A centifugal pump impeller whose external and internal diameters are 400 mm and 200 mm respectively is running at 950 rpm. The rate of flow through the pump is 0.035 m^3/s. The suction and delivery heads are 5 m and 25 m respectively. The diameter of the suction and delivery pipes are 120 mm and 80 mm respectively. If the outlet vane angle is 45 $^{\circ}$, the flow velocity is constant and equal to 1.8 m/s and power required to drive the pump is 15 kW, determine :

i) inlet vane angle;

ii) the overall efficiency; and

iii) the manometric efficiency.

(15 marks)

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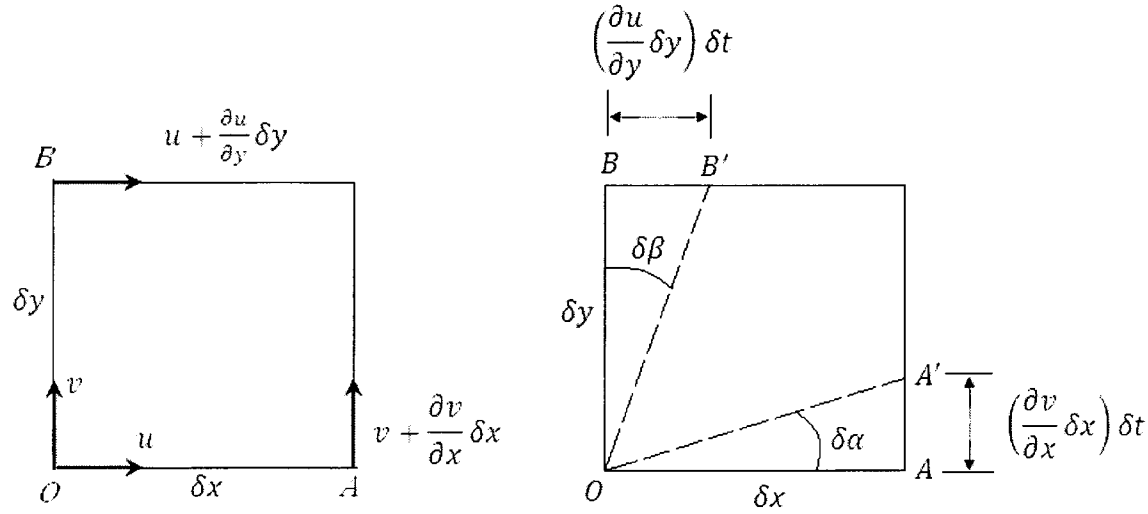

FIGURE Q2(a)