UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	FLUID MECHANICS II
COURSE CODE	:	BDA 30203 / BDA 3023
PROGRAMME	:	BACHELOR IN MECHANICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR** QUESTION ONLY

THIS EXAMINATION PAPER CONTAINS FIVE (5) PAGES

Q1 (a) List down three main regions in turbulent velocity profile and show them through an appropriate illustration.

(4marks)

(b) With aided of appropriate illustration, for horizontal pipe with constant diameter, discuss about pressure distribution at the entrance region and fully developed region.

(4marks)

(c) Water with density, ρ = 998 kg/m^3 and viscosity, μ = 0.001 kg/ms flows through the smooth pipe with diameter of 6 cm and length of 12 m. The flow is turbulent, so that the logarithmic law is valid. If the shear stress in the fluid is 15 Pa and the average velocity occurred at r = 2/3R, determine;

(i) The thickness of viscous sub layer,

(ii) The average velocity, and

(iii) The head loss due to friction.

(17 marks)

Q2 (a) Derive the momentum equation for a viscous flow. Apply forces in the x direction only.

(15 marks)

(b) Two-dimensional, inviscid flow with velocity field $\mathbf{V} = (Ax + B)\,\mathbf{i} + (C - Ay)\,\mathbf{j}$.

(i) Show that the flow is irrotational.

(2 marks)

(ii) Formulate an expression for the velocity potential.

(8 marks)

Q3 (a) Illustrate shear stress and streamline over an aerofoil with symmetrical geometry, vertical cylinder and horizontal hemisphere.

(4 Marks)

(b) List down the layer of **boundary layer thickness** behavior for an aerofoil (from leading edge towards the end) with angle of attack 0°, 15° and 30° with short description.

(6 marks)

(c) A jumbo jet airplane has a mass of about 400,000 kg when fully loaded with over 400 passengers and takes off at a speed of 250 km/h. Determine;

(i) Relation between takeoff velocities with weight of the jumbo jet airplane.

(ii) The takeoff speed when the airplane has 100 empty seats. Assume each passenger with luggage is 140 kg and the wing and flap settings are maintained the same.

(iii) The takeoff speed when the airplane has 50 empty seats. Assume 50% passenger with luggage is 100 kg while the balance with luggage 150 kg, the wing and flap settings are maintained the same.

(15 marks)

Q4 (a) The suction pipe for centrifugal pump is bigger compare to the delivery pipe. Why the design should be like the statement.

(3 marks)

(b) Identify and explain the working principles of impulse and reaction turbines with an example of each it.

(7 marks)

(c) An axial flow pump operates at 500 rpm. The outer diameter of the impeller is 750 mm and the hub diameter is 400 mm. at the mean blade radius, the inlet blade angle is 12^{o} and the outlet blade angle is 15^{o} both measured with respect to the plane of impeller rotation. Sketch the corresponding velocity diagrams at inlet and outlet and determine;

(i) The head generated by the pump,

(ii) The rate of flow through the pump, and

(iii) The shaft power consumed by the pump if the overall efficiency of the pump is 70%.

(15 marks)

Q5 (a) Explain a method to approximate speed of sound in air.

(5 marks)

(b) Air flows in an insulated duct. At point **1** the conditions are $M_1 = 0.1$, $T_1 = 20$ °C, and $p_1 = 1.0$ MPa (abs). Downstream, at point **2**, because of friction the conditions are $M_2 = 0.7$, $T_2 = -5.62$ °C, and $p_2 = 136.5$ kPa (abs). Given R = 287 J/kgK, c_p = 1004 J/kgK and k = 1.4

(i) Compare the stagnation temperature at points **1** and **2**, and explain the result.

(ii) Compute the stagnation pressures at points **1** and **2**.

(iii) Explain how it can be that the velocity 'increases' for this frictional flow.

(iv) Determine whether the process is isentropic or not. Provide suitable calculations to support your answer.

(20 marks)