FACULTY: ENGINEERING

DEPARTMENT: AUTOMOTIVE & MECHANICAL ENGINEERING

SECOND SEMESTER EXAMINATIONS

2015/ 2016 ACADEMIC SESSION

HOD'S SIGNATURE

COURSE CODE: GNE 224

COURSE TITLE: FUNDAMENTALS OF FLUID MECHANICS

DURATION: 2 HOURS 30 MINUTES

INSTRUCTIONS

1. ATTEMPT ANY **FOUR** QUESTIONS OF YOUR CHOICE
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM
3. YOU ARE NOT ALLOWED TO BORROW CALCULATORS AND ANY OTHER WRITING MATERIALS

1a. State and prove Pascal's law. **(9½ marks)**

b. A multiple U-tube manometer is fitted to a pipe with center at A as shown in Fig. Q1b. Determine the pressure at A. **(5½ marks)**

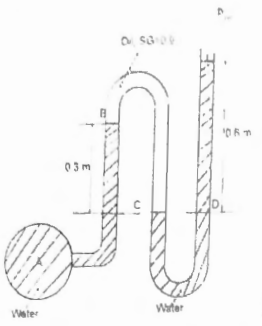

Fig. Q1b

2a. Derive an expression for the force on a thin plate of given arbitrary shape immersed in a liquid at an angle θ to the free surface. State the expressions for the center of pressure of the plate. **(9 marks)**

b. A wall of a reservoir is inclined at 30° to the vertical. A sluice 1 m long along the slope and 0.8 m wide is closed by a plate. The top of the opening is 8 m below the water level. Determine the location of the center of pressure and the total force on the plate. **(6 marks)**

3a. State the Archimedes' principle. **(2 marks)**

b. Define and explain the following terms (i) Metacenter (ii) Metacenter height **(6 marks)**

c. A wooden block of width 2.5 m, depth 1.5 m and length 6 m is floated horizontally in water. If the specific gravity of block is 0.65. Find (i) the volume of water developed, and (ii) position of the center of buoyancy **(7 marks)**

4a. Define the following properties of fluid;

(i) density, (ii) specific weight, (iii) specific gravity, (iv) viscosity **(4 marks)**

b. The velocity of fluid filling a hollow cylinder of radius 1 m varies as $u = 10\left[r - \frac{r^2}{0.1}\right]$ m/s along the radius r. the viscosity of the fluid is 0.018 Ns/m^2. For 2 m length of the cylinder, determine the velocity, shear stress and shear force over cylindrical layer of fluid at r = 0.7m. **(8 marks)**

c. An open cylindrical vertical container is filled with water to a height of 30 cm above the bottom and over that an oil of specific gravity 0.82 for another 40 cm. the oil does not mix with water. If the atmospheric pressure at that temperature is 1 bar, determine the absolute and gauge pressure at the oil-water interface. **(3 marks)**

5a. Derive the continuity equation for an incompressible steady flow fluid. **(5 marks)**

b. Air enters a compressor with a density of 1.2kg/m^3 at a mean velocity of 4 m/s in the 6cm x 6cm inlet duct. Air is discharged from the compressor with a mean velocity of 3m/s in a 5cm diameter circular pipe. Determine the mass flow rate and the density at the outlet. **(4½ marks)**

c. A jet of water of 20mm in diameter exits a nozzle directed vertically upward at a velocity of 10m/s. assuming the jet retains a circular cross section, determine the diameter of the jet at a point 4.5m above the nozzle exit. Take ρ_{water} = 1000kg/m^3. **(5½ marks)**