MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 209 FLUID MECHANICS

DATE: 16/5/2019 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS:

Answer question one and any other two question.

QUESTION ONE (COMPULSORY QUESTION) (30 MARKS)

a) i Explain with the aid of well leveled diagrams, the mode of operation of a hydraulic jack (3 marks)

ii. In a hydraulic jack a force F is applied to the small piston to lift the load on the large piston, both pistons being at the same level. The diameter of the small piston in 20 mm and the diameter of the large piston is 200mm. Calculate the value of force F required to lift load of mass 1200 kg (3 marks)

iii. If the diameter of the small piston is 0.65m above that of the large piston, calculate the effort required to lift the load of mass 1200 kg (3 marks)
Assume density of water = 10^3kg /m^3
Acceleration due to gravity = 9.81m/sec^2

b) i A U-tube mercury manometer is used to measure a gauge pressure of water at A in the attached flask as shown in fig1 . Calculate the gauge pressure at A
When h_1 = 0.15 m, and h_2 = 0.3 m
Assume: density of water = 10^3 kg /m^3
Specific gravity of mercury = 13.6 (5 marks)

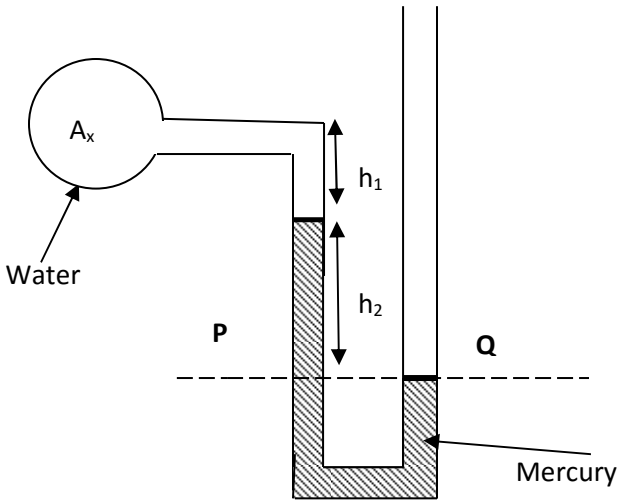

Fig 1

c) i Distinguish between turbulent and laminar flows (3 marks)

ii. What is the physical meaning of Reynolds's number? (2 marks)

iii. Water is discharged through a 150 mm diameter pipe at rate 0.000356 m^3/sec. The coefficient of dynamic viscosity of water = 1.14 x10^{-3} $\frac{kg}{m-s}$ and density of Water = 10^3 kg /m^3.

Calculate the Reynold's number of the flow (3 marks)

iv. Determine whether or not the flow is turbulent or laminar (2 marks)

d) A cylindrical vessel of diameter 1.4 m containing water is given a vertical acceleration of 5 m / sec in an upward direction. The depth of water in the vessel 0.85m

Calculate the force at bottom of the vessel if:

i) it is being accelerated at 5m/sec^2 (3 marks)

ii) acceleration stops and the vessel continues to move. (3 marks)

QUESTION TWO (20 MARKS)

a) Derive Bernoulli's Equation for incompressible frictionless fluid from momentum consideration (10 marks)

b) Oil flows through a horizontal pipe which varies uniformly in cross-section from 150mm diameter at A to 225 mm diameter at B.

c) At A the gauge pressure is 126KN/m^2 and at B 140 KN/m^2

Calculate the discharge in :

i. Metres cubed per sec (m^3/sec)

ii. Kilograms per sec (kg/sec)

Assume: density of water =10^3 kg /m^3 (5 marks)

Relative density of oil = 0.8 (5 marks)

QUESTION THREE (20 MARKS)

a) Define the term center of pressure (2 marks)

b) Show that for a completely submerged vertical flat plate , the center of pressure $\bar{h}$ vertically below the free surface is given by:

$$\bar{h} = \frac{k^2}{\bar{x}} + \bar{x}$$

When k = radius of gyration

$\bar{x}$ = the depth of the center of area of the plate below the free surface (8 marks)

c) A circular flat plate is vertically immersed in water so that the geometric center of the plate is 1.6 m below the free surface and the depth of center of pressure is 1.7410m also vertically below the free surface.

Calculate the:

i. diameter of the plate (6 marks)

ii. total force acting on the plate (4 marks)

QUESTION FOUR (20 MARKS)

a) Show that the discharge through an inclined venturimeter depends on the pressure head difference between the pipe and the throat only (12 marks)

b) A horizontal venturemeter has an inlet diameter of 100mm and a throat diameter of 50mm. The flow rate through the meter is 0.015 m^3/sec

Calculate the pressure head difference in meters of water (8 marks)

Assume C_d for the metre = 0.96

QUESTION FIVE (20 MARKS)

a) Distinguish between impulse and reaction turbines? (4 marks)

b) A pelton wheel has a mean bucket speed of 10.0m/sec, and the jet discharges 0.70 m^3/sec under a head of 30.0m. The deflection angle is 160^0 and the C_v for the nozzle is 0.98.

Calculate the power developed

Assume, the friction is negligible (16 marks)