THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A constituent College of JKUAT)

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN CHEMICAL ENGINEERING

ECH 2308 : FLUID MACHINES IV

YEAR II SEMESTER II

SPECIAL/SUPPLEMENTARY EXAMINATION
MAY 2012 SERIES
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

You should have the following for this examination:

- Answer booklet
- Scientific Calculator
- Drawing instruments

This paper consists of **FIVE** questions

Attempt any **THREE** questions. Maximum marks for each part of a question are as shown.

This paper consists of 3 printed Pages

Question ONE

a) i. Sketch the Theoretical Pressure / volume diagram for the cylinder of a reciprocating pump, which is not fitted with air, vessels, showing clearly the effect of acceleration and friction in both suction and delivery pipes.

ii. State the condition under which 'separation' occurs. *(10marks)*

b) The following date relate to a pump without air vessel; length of suction pipe 9m; diameter of suction pipe 75mm; suction lift 3m; plunger diameter 125mm; stroke 300mm; speed 30rev/min. Calculate the theoretical absolute pressure head in metres of water at the beginning and end of suction stroke. Barometric pressure corresponds to 10.2m of water. *(10marks)*

Question TWO

a) Define the following:
   i. Fundamental dimension
   ii. Derived dimension
   iii. Geometric similarity
   iv. Dynamic similarity *(8marks)*

b) Show by dimensional analysis that the resistance to motion R of a body moving partially submerged through a viscous, compressible fluid is given by

$$R = PV^2 l^2 \phi\left(\frac{pvl}{\mu}\right)$$

where

P = density,
V = velocity
L = characteristic length
μ = dynamic viscosity *(12marks)*

Question THREE

A jet of water of 50mm diameter having a velocity of 24m/s impinges tangentially on a series of varies which when stationary deflect the jet through an angle of 120 degrees.

Calculate the magnitudes of the force on the vanes in the direction of motion when they are

a) Stationary *(8marks)*
b) Moving with velocity of 9m/sec in the same direction as the jet. *(6marks)*
c) The work done per second in the vanes when the vanes are moving. *(4marks)*

Question FOUR

Given that, in, viscous flow, the velocity of flow between parallel plates is

$$u = \frac{p}{2\mu}(y^2 - hy),$$ $$Q = \frac{pbh^3}{12\mu}$$

show that the rate of flow is

Where

P	=	Pressure drop
B	=	width of plates
µ	=	viscosity
l	=	length fluid element
h	=	distance of one plate from the other and
y	=	distance of fluid element from the lower plate.

(10marks)

c) The radial clearance between a plunger and the walls of a cylinder is 0.075mm; the length of the plunger is 250mm and its diameters is 100mm. There is a difference in pressure of the water on the two ends of the plunger of 207 KN/m^2 and the viscosity of the water is 1.31 x 10^{-3} kg/m-s. Treating the flow as if it occurred between parallel flat plates, estimate the rate of leakage in litres/sec. *(10marks)*

Question FIVE

a) State the principle of Archimedes and explain its application to a floating body. *(4marks)*

b) A horizontal culvert with a trapezoidal section 150cm wide at the top, 90cm wide at the bottom and 1.8m high, with sides inclined equally to the vertical, connects at one end to a reservoir in which the water surface is level with the top of the culvert and is closed at the other end by a vertical bulk head fixed by lugs at the four corners. Calculate the total force due to water on the bulkhead and the force exerted on each fixing log. *(16marks)*