THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of engineering &technology

Department of mechanical & automotive engineering

DIPLOMA IN
MECHANICAL ENGINEERING
AUTOMOTIVE ENGINEERING
PRODUCTION ENGINEERING

EME 2302
FLUID MECHANICS III

YEARIII- SEMESTER I
SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: OCTOBER 2011

TIME: 2 HOURS

Instructions to candidates

You should have the following for this examination:

- Answer Booklets
- Scientific Calculator
- Drawing Paper
- Drawing Instruments

This paper consists of **FIVE** questions.
Answer questions **ONE** and any **TWO** other questions.
Maximum marks for each part of the question is shown
This paper consists of ***THREE printed pages.***

QUESTION ONE

(a) Define the following terms as applied to fluid flow:

(i) Steady flow
(ii) Uniform flow

(4 Marks)

(b) (i) Name **TWO** causes of head loss in fluid flow through pipes.

(ii) Show that the loss of head in a flowing fluid due to sudden enlargement in pipe cross-section is given by:

$h = \frac{(V_1 - V_2)^2}{2g}$ where V_1 is velocity in the pipe upstream and V_2 is velocity of flow in pipe downstream of the function. **(13 Marks)**

(c) Two water reservoirs whose difference in level is 15m are connected by a pipe 40m long. The first 20m of the pipe from the tank is 40mm in diameter while the next 20m is 60mm in diameter. Calculate the rate of flow. For both pipes, friction factor f = 0.054. Assume no loses at entry to and exist from the pipe. **(13 Marks)**

QUESTION TWO

(a) Derive from Bernoulli's theorem expressions for:

(i) Theoretical velocity

(ii) Theoretical discharge through a small orifice. Explain the symbols used.

(7 Marks)

(b) A sharp edged orifice 50mm in diameter in the vertical side of a tank discharges water under a head of 3m. If for the coefficient of contraction Co = 0.62 and coefficient of velocity Cr = 0.98.

Calculate:

(i) The theoretical velocity

(ii) The actual velocity

(iii) The horizontal distance of the jet at a vertical distance of 1.8m below the orifice.

(13 Marks)

QUESTION THREE

(a) Define the following:

(i) Fundamental dimensions
(ii) Derived dimensions

(4 Marks)

(b) The variables controlling the motion of a floating vessel through water are known to be the drag force f, spread of a distance u, length l , density ρ, dynamic viscosity μ and gravitational acceleration g. show by dimensional analysis that a possible relationship between the drag force and the other variables is $F = \rho u^2 l^2 \phi\left(\frac{\rho u l}{\mu}, \frac{u}{\sqrt{eg}}\right)$ where ϕ means "function of". **(16 marks)**

QUESTION FOUR

(a) Sketch the lift pump and describe its operation. **(8 Marks)**

(b) Sketch the indicator diagram for a single cylinder reciprocating pump. Show clearly the effect of acceleration and friction in both suction and delivery pipes. **(6 Marks)**

(c) Explain why the available lift for a reciprocating pump is limited to only about 8m when pumping water instead of the equivalent atmospheric pressure head of 10.4m. **(6 Marks)**

QUESTION FIVE

(a) Show that in viscous flow the velocity of a cylindrical element of radius r, flowing through a pipe of radius R is given by:

$u = \frac{P}{4\mu l}\left(R^2 - r^2\right)$ and that flow rate

$Q = \frac{\pi P R^2}{16\mu L}$

where:

P = Pressure drop
l = Length of plates
μ = Dynamic viscosity

(12 Marks)

(b) Oil of viscosity $0.048 kgm^{-1}s^{-1}$ flow through an 18mm diameter pipe. With mean velocity $0.3ms^{-1}$. Calculate the pressure drop which occurs over a length of 45m. **(8 Marks)**