MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2018/2019 ACADEMIC YEAR
FOURTH YEAR SECOND SEMESTER

SCHOOL OF SCIENCE
BACHELOR OF SCIENCE

COURSE CODE: MAT 417
COURSE TITLE: FLUID MECHANICS II

DATE: 25TH APRIL 2019 **TIME: 1430 – 1630 HRS**

INSTRUCTIONS TO CANDIDATES

1. Answer Question **ONE** and any other **two** questions.
2. All Examination Rules Apply.

QUESTION ONE

a) Define the following terms
   i) Free-Vortex flow **(2 marks)**
   ii) Source and Sink **(2 marks)**
   iii) Conformal transformation **(2 marks)**

b) State the blasius theorem **(3 marks)**

c) Write down the navier stokes equations for cartesian coordinates **(6 marks)**

d) Show that the two families of curves

$$\phi(x, y) = c_1$$
$$\psi(x, y) = c_2$$

Intersect at right angles. **(5 marks)**

e) If the stream lines (path of the fluid particles) of a flow around a corner are M $xy = \text{constant}$. Find their orthogonal trajectories (equipotential).

(5 marks)

f) Describe the transformation $w = e^z$, where $w = u + iv$ and $z = x + iy$. **(5 marks)**

QUESTION TWO

a) A viscous fluid is flowing between two concentric circular cylinders of radii a and b $(b > a)$ rotating with angular velocities ω_1 and ω_2 respectively. Show that the velocity distribution is

$$v = \frac{1}{b^2 - a^2}\left[\left(b^2\omega_2 - a^2\omega_1\right)r - \frac{a^2b^2}{r}(\omega_2 - \omega_1)\right]$$ **(11 marks)**

b) Determine the velocity distribution of the flow of the fluid through an infinite circular pipe of radius a taking that the velocity vector is $\mathbf{q} = (0, 0, u)$. Also find the skin friction at the pipe.

(9 marks)

QUESTION THREE

a) A fluid of density ρ is confined over a plane $y = 0$. Let $t = 0$, the plate $y = 0$ (which is initially at rest) starts moving with velocity U along the x – axis. Find the velocity distribution of the fluid using laplace transformation method.
(11 marks)

b) Describle the plane coutte flow and plane poiseullie flow. **(9 marks)**

QUESTION FOUR

a) Show that for an incomplessible steady flow with constant viscosity

$$u(y) = y\frac{U}{h} + \frac{h^2}{2\mu}\left[-\frac{\partial p}{\partial x}\right]\frac{y}{h}\left(1-\frac{y}{h}\right)$$

$$v = 0 = w$$

Satisfy the equation of motion, where the body force is neglected. h, U and $\frac{dp}{dx}$ are constants and $p = p(x)$ **(10 marks)**

b) Find the equations of stream lines due to uniform line sources of strength m per unit length through the points $A(-a,0), B(a,0)$ and a uniform line sink of strength –m per unit length through the origin.

(10 marks)

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