MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATION
2023/2024 ACADEMIC YEAR
THIRD YEAR SECOND SEMESTER
EXAMINATIONS

SCHOOL OF PURE AND APPLIED SCIENCES
BACHELOR OF SCIENCE

COURSE CODE: MAT 4236-1
COURSE TITLE: FLUID MECHANICS II

DATE: 22/4/24 **TIME:1100-1300HRS**

INSTRUCTIONS TO CANDIDATES

1. This paper contains **FOUR** (4) questions
2. Answer question **ONE (1)** and any other **TWO** (**2**) questions
3. Do not forget to write your Registration Number.

QUESTION ONE (20 MARKS)

a) Let there be a source of strength m at (a, 0) and sink of strength –m at (-a, 0). Find velocity q.

[5mks]

b) Show that the resistance R to the motion of a sphere of diameter D moving with a uniform velocity V through a real fluid having density ρ and viscosity μ is given by.

$R = \rho D^2 V^2 f\left(\frac{\mu}{\rho VD}\right)$. [5mks]

c) Define Reynolds number and state its importance in fluid flow [5mks]

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d) State and prove The Milne- Thomson Circle theorem. [5mks]

QUESTION TWO (20 MARKS)

a) Two Sources, each of strength m are placed at the points (-a, 0), (a,0) and a sink of strength 2m at the origin. Show that the stream lines are the curves $\left(x^2+y^2\right)^2 = a^2\left(x^2-y^2+\lambda xy\right)$ where λ is a variable parameter.

Show also that the fluid speed at any point is $\frac{2ma^2}{(r_1 r_2 r_3)}$, where r_1, r_2 and r_3 are the distances of the points from the sources and the sink.. [10mks]

b) Discuss the flow due to a uniform doublet at point O of strength μ per unit length if its axis is along the x axis. [5mks]

QUESTION THREE (15 MARKS)

a). Let $w = \phi + i\varphi$ be the complex velocity potential of an incompressible fluid flow in a two dimensional motion under no external pressure. If the pressure thrusts on the fixed cylinder of any shape are represented by a force(X, Y). Prove that

: $X - iY = \frac{i\rho}{2}\int_c \left[\frac{dw}{dz}\right]^2 dz$. [8mks]

b). A two dimensional flow field is given by $\psi = xy$

i) Show that the flow is irrotational
ii) Find the velocity potential
iii) Verify that ψ and ϕ satisfy the Laplace equation [6mks]

QUESTION FOUR (15 MARKS)

a) Between the fixed boundaries $\theta = \frac{\pi}{6}$ and $\theta = \frac{-\pi}{6}$ there is a two dimensional liquid motion due to a source at the point ($r = c, \theta = \alpha$) and sink at the origin absorbing water at the same rate as the source produces. Find the stream function and show that one of the stream lines is a part of the curve $r^3 \sin 3\alpha = c^3 \sin 3\theta$ [8mks]

b) The resistance R experienced by a partially submerged body depends upon the velocity V, length of the body l, viscosity of the fluid μ, density of the fluid ρ and gravitational acceleration g.. Using Buckingham's theorem, find an expression for R. [7mks]

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