

**TECHNICAL UNIVERSITY OF MOMBASA**

FACULTY OF APPLIED AND HEALTH SCIENCE

DEPARTMENT OF MATHEMATICS AND PHYSICS

**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE.**

**AMA 4326: FLUID MECHANICS II**

END OF SEMESTER EXAMINATION**: MAY 2016** - **SERIES**

**TIME:** 2 HOURS

**Instructions to Candidates**

You should have the following to do this examination:

*-Answer Booklet, examination pass and student ID*

**Do not write on the question paper.**

**Answer question one and any other two**

**Question one: 30 marks (Compulsory)**

1. Briefly describe the following standard conformal transformations:
2. Inversion 1 mark
3. Enlargement 1 mark
4. Prove that is an analytic function. 4 marks
5. Two parallel plates kept 100mm apart have laminar flow of oil between them with a maximum velocity of 1.5m/s and viscosity of oil 2.45Ns/m2.

Calculate: i) The discharge per metre width. 2 marks

ii) The shear stress at the plates. 3 marks

d) Find a relevant stream function for a set of velocity components  and to obtain a steady incompressible flow. 6 marks

e) State the Blasius theorem. 3 marks

f) What is the irrotational velocity field associated with the potential  Does the flow field satisfy the incompressible continuity equation? 5 marks

g) Prove that the transformation maps the circle  in the Z plane onto a circle in the w plane and maps circles in the Z plane through the origin onto a straight line in the w-plane. 5 marks

**Question TWO (20 marks)**

1. Fluid is in laminar motion between two parallel plates under the action of motion on one of the plates and also under the presence of a pressure gradient in such a way that the net forward discharge across any section is zero:
2. Find out the point where minimum velocity occurs and its magnitude. 7 marks
3. Draw the velocity distribution profile (sketch graph) across a section of the parallel plates. 2 marks
4. The velocity components in a fluid flow are given by 

 i) Show that the flow is possible. 2 marks

 ii) Derive the relative stream function. 4 marks

1. If streamlines are represented by determine the velocity and its direction at (3, 4) . 5 marks

**Question THREE (20 marks)**

1. Discuss the flow pattern due to a line source at the origin of a complex potential function. 4 marks
2. In a pipe of 300mm diameter the maximum velocity of flow is found to be 2m/s, if the flow in the circular pipe is laminar. Find :
3. The average velocity and the radius at which it occurs. 5 marks
4. The velocity at 50mm from the wall of the pipe. 2 marks
5. Consider a conformal mapping , show that the curve  transforms to  where  in the *w* - plane. 6 marks
6. Determine a relevant stream function to a set of velocity components of steady incompressible flow if u=2cx and v = -2cy. 3 marks

**Question FOUR (20 marks)**

1. Define the following terms as used in fluid mechanics:
2. Incompressible flow. 1 mark
3. Equipotential line. 1 mark
4. Discuss the flow due to a uniform line doublet at point O of strength per unit length if its axis is along the x- axis. 7 marks
5. A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30mm diameter pipe, if the pressure drop per metre length of pipe is 20KN/m2. Determine
6. The mass flow rate in kg/min. 4 marks
7. Shear stress at the pipe wall. 2 marks
8. The Reynolds number for the flow. 2 marks
9. Show whether the function  represents a possible irrotational flow. 3 marks

**Question FIVE (20 marks)**

1. The velocity distribution in a pipe is given by where Umax is the maximum velocity at the centre of a pipe, U is the velocity at a distance r from the centre and R is the pipe radius. Obtain an expression for mean velocity in terms of Umax and n. 5 marks

b) The flow field of a fluid is given by :

i) Show that it represents a possible 3 dimensional steady incompressible continuous flow. 2 marks

ii) Is this flow rotational or irrotational. 2 marks

1. If irrotational determine at point A (2, 4, 6) the value of angular velocity and vorticity. 4 marks
2. If there is a line source of strength m at a point Z and a line source of equal strength at the mirror image of z1 at the line x=0. Prove that there is no fluid motion across the mirror x=0. 7 marks

**THE END**