

**W1-2-60-1-6**

**JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2016/2017**

THIRD YEAR SECOND SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE

**SMA 2322: FLUID MECHANICS I**

**DATE: JULY, 2017 TIME: 2 HOURS**

INSTRUCTIONS: ANSWER QUESTION ONE (COMPULSORY) AND ANY

OTHER TWO QUESTIONS

**QUESTION ONE: 30 MARKS**

a. Explain briefly what is meant by the following thermodynamic processes:

i. Isobaric process. (2 marks)

ii. Adiabatic process. (2 marks)

b. Determine the dimensions of the following quantities in the M-L-T system.

i. Force. (2 marks)

ii. Discharge. (2 marks)

c. The velocity components in the and  directions are given as  and . Indicate whether the given velocity distribution is a possible field of flow or not. (5 marks)

d. Given the characteristic equation of state of a perfect gas as PV=MRT, show that the differential equation of the perfect gas is

 (4 marks)

e. A 120mm diameter pipe reduces to 60mm diameter through a sudden contraction when it carries air at 250C under isothermal conditions, the absolute pressures observed in the two sections of the pipe just before and just after the contraction are 480KN/m2 and 384KN/m2 respectively.

Determine the densities at the two sections. (Take R=28.

(6 marks)

f. The velocity distribution of a 2D flow is given by and  where a,b, and c are constants. Find the path lines of the fluid particles if at  (7 marks)

**QUESTION TWO: 20 MARKS**

a. i. State Bernoulli’s equation. (2 marks)

ii. A pipe 200m long slopes down at 1 in 100 and tapers from 600mm diameter at the higher end to 300mm diameter at the lower end, and carries 100 liters/sec of oil of density 0.8kg/m3. If the pressure gauge at the higher end reads 60kN/m2, determine:

1. The velocities at the two ends. (4 marks)

2. The pressure at the lower end. (3 marks)

Ignore all the losses and take g=9.81N/kg)

b. In 3 incompressible fluid flow, the velocity components in x and y directions are:-

and 

Use continuity equation to evaluate an expression for the velocity component in the  direction. (16 marks)

c. Given and What is the most general form of V so that the flow is possible for a steady 3 incompressible flow?

(5 marks) 

**QUESTION THREE: 20 MARKS**

a. Define the following terms:-

i. A streamline. (2 marks)

ii. A path line. (2 marks

b. A 2 flow towards a normal boundary is found to be characterized by a normal component of the velocity that varies directly with distance from the boundary. Determine the stream function and the streamlines. (6 marks)

c. Find whether the flow with velocity components

 , V=

 is rotational or irrotational. (10 marks)

**QUESTION FOUR: 20 MARKS**

a. Determine whether the velocity component set given below satisfies the equation of continuity. (4 marks)





b. The velocity distribution for flow over a plate is given by .

Where is the velocity in m/s and  is the distance from the plate boundary in metres. Determine:-

i. The velocity gradient and the shear stress at the boundary.

(3 marks)

ii. The velocity gradient and the shear stress at 0.18m from the boundary. (3 marks)

(Take viscosity=0.9N5/m2)

c. Calculate:-

i. The specific weight

ii. A liquid having a volume of 6m3 and weight 45000N. (4 marks)

(Take g=9.81N/kg)

d. When the pressure of a liquid is increased from 4its volume is found to decrease by 0.08%. What is the bulk modulus of elasticity of the liquid? (3 marks)

e. State any three uses of dimensional analysis. (3 marks)