TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MEDICAL ENGINEERING

UNIVERSITY EXAMINATION FOR:

THE DEGREE IN BACHELOR OF IN MEDICAL ENGINEERING

EME 4353 : Fluid Mechanics II

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: Pick Date Sep 2018

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of Choose No questions. Attempt Choose instruction.

Do not write on the question paper.

Question ONE

a) Define the following terms
   i. Vortex flow
   ii. Force vortex flow.
   iii. Free vortex flow. (6 marks)

b) Derive the equation for the depth of the parboloid formed by the surface of a liquid contained in a cylindrical tank which is rotated at a constant angular velocity ώ about its vertical axis. (6 marks)

c) A cylindrical vessel 12 cm in diameter and 30cm deep is filled with water upto the top. The vessel is open at the top. Find the quantity of liquid left in the vessel, when it is rotated about its vertical axis with a speed of
   i. 3000 r.p.m
   ii. 600 r.p.m (8 maks)

Question TWO

a) Define the functions
   i. Velocity potential function
   ii. Stream function. (6 marks)

b) The velocity potential function for a two dimensional flow is

$$\emptyset = x(2y - 1)$$

At a point P(4,5) Determine
   i. The velocity
   ii. The Value of the stream function. (7 marks)

c) The stream function for a two dimensional flow is given by $\psi = 2xy$. Calculate velocity function at point P(2,3).Find the velocity potential function ϕ (7 marks)

Question THREE

a) Describe compressible.flow. (2 marks)

b) Define the following terms
   i. Subsonic flow
   ii. Sonic flow
   iii. Supersonic flow
   iv. Mach cone (6 marks)

c) Calculate the Mach number at a point on a jet propelled aircraft, which is flying at 1100 km/hour at sea level where air temperature is 20oC.Take k=1.4 and R=287j/kg K. (4 marks)

d) A gas is flowing through a horizontal pipe at a temperature of 4 ^{O}c .The diameter of the pipe is 8 cm and at a section 1-1 in the pipe,the pressure is 30.0N/cm^2 (gauge).The diameter of the pipe changes from 8 cm to 4 cm at the section 2-2, where the pressure is 20.3 N/cm^2 (gauge).Find the velocities of the gas at these sections assuming an isothermal process. Take R=287Nm/kg K, and atmospheric pressure 10=10N/cm^2 (10 marks)

Question FOUR

a) Define the following Terms
   i. Boundary layer Thickness
   ii. Displacement Thickness
   iii. Momentum Thickness
   iv. Energy Thickness (8 marks)

b) The velocity distribution in the boundary layer is given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

δ being boundary layer thickness

Calculate the following

   i. Displacement.
   ii. Momentum thickness

iii. Energy thickness. (12 marks)

Question FIVE

a) Describe the types of flow lines
   i. Path line.
   ii. Streamline
   iii. Stream tube
   iv. Streak line (6 marks)

b) In a fluid ,the velocity field is given by

$$V = (3x + 2y)i + (2z + 3x^2)j + (2t - 3z)k$$

Calculate
   i. The velocity components *u,v,w* ant any point in the flow field
   ii. The speed at point (1,1,1)
   iii. The speed at time t =2s at point (0,0,2) (6marks)

c) For the velocity field given by

Type equation here.

$$V = 10xyi + 5x^2j + t^2x + z)k$$

Find the velocity and acceleration of a fluid particle at (1,2,3) when t=1 (8 marks)