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**University Examinations 2015/2016**

SECOND YEAR FIRST SEMESTER EXAMINATION

FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

**EMT 3254: FLUID MECHANICS II**

**DATE: APRIL 2016 TIME: 2 HOURS**

**INSTRUCTIONS:** *Answer question* ***one*** *and any other* ***two*** *questions*

**QUESTION ONE (30 MARKS)**

1. Define the following terms
2. Pathline (1 mark)
3. Streakline (1 mark)
4. Streamline (1 mark)
5. Boundary layer (1 mark)
6. Differentiate the following terms as used in the analysis of fluid flow.
7. Uniform flow and steady flow (2 marks)
8. Real and ideal fluids (2 marks)
9. Compressible and incompressible flow (2 marks)
10. Explain the difference between one-dimensional flow and two-dimensional flow. (2 marks)
11. A particle moves from A to B along a curved path of length subtending a small angle  st the centre of curvature. This motion and the corresponding velocity diagram is represented in figure (i) below. If  is the change of velocity perpendicular to the direction of motion, show that the acceleration perpendicular to the direction of motion, , is given by:

 where R is the radius of curvature of the circular path. (4 marks)

1. Glycerin at 250c flows through a pipe of diameter 150mm at velocity of 3.6m/s. If the density and coefficient of dynamic velocity of glycerin at this temperature are 1258kg/m3 and 0.96 kg/m.s respectively, determine Reynolds’s number and hence classify the type of flow. (4 marks)
2. A submarine-launched died missile, 1m diameter by 5m long, is to be studied in a water tunnel to determine the loads acting on it during its underwater launch. The maximum speed during this initial part of the missile’s flight is 20ms-1. Calculate the mean water tunnel flow velocity if a 1/20 scale model is to be employed and dynamic similarity is to be achieved. (4 marks)
3. Calculate the loss of head due to friction and the power required to maintain flow in a horizontal pipe of 40mm diameter and 750m long when water (coefficient of dynamic viscosity ) flows at a rate of 4L/min. Assume that for the pipe the absolute roughness is 0.00008m (6 marks)

**QUESTION TWO (20 MARKS)**

1. State the difference between Laminar and Turbulent flow (2 marks)
2. Laminar flow of a fluid of viscosity  and density occurs between a pair of parallel plates of extensive width, inclined at 450 to the horizontal, the plates being 10mm apart as shown in figure (ii) below. The upper plate moves with a velocity 1.5ms-1 relative to the lower plate and in a direction opposite to the fluid flow. Pressure gauges, mounted at two point 1.4m vertically apart on the upper plate, and record pressures of and respectively. Determine
3. Velocity distribution between the plates (3 marks)
4. Shear stress distribution between the plates (3 marks)
5. Maximum flow velocity (3 marks)
6. Shear stress on the upper plate (3 marks)
7. In a water pipeline, there is an abrupt change in diameter from 180 to 350mm. If the head lost due to separation when the flow is from the smaller to the larger pipe is 0.6 m greater than the head lost when the same flow is reversed, determine the flow rate. Take the loss coefficient  (6 marks)

**QUESTION THREE (20 MARKS)**

1. Using a neat sketch, illustrate the meaning of displacement thickness as used in the boundary layer theory. (4 marks)
2. A smooth flat plate 3.5m wide and 40m long is towed through still water at 300c at a speed of 8ms-1. Determine the total drag on the plate. (4 marks)
3. The layer of velocity profile is given by where u is the velocity at height y above the surface and the flow free stream velocity is . Determine
4. Ratio of the momentum thickness to the boundary layer thickness (3 marks)
5. Ratio of displacement thickness to the boundary layer thickness  (3 marks)
6. Air at 200c and with a free stream velocity of 50m/s flow past a smooth thin plate which is 2.5m wide and 12 m long in the flow direction. Assuming a turbulent boundary layer from the leading edge, determine the following quantities at a distance of 6 m from the leading edge.
7. Shear stress (2 marks)
8. Laminar sub-layer thickness (2 marks)
9. Boundary layer thickness (2 marks)

Take density = 1.2kg/m3 and kinetic viscosity as 

**QUESTION FOUR (20 MARKS)**

1. Differentiate between flow in a closed conduit and flow in an open conduit (2 marks)
2. Water discharges from a reservoir A (As shown in figure (iii) below) through a 120 mm pipe 20m long which rises to its highest point at B, 1.8m above the free surface of the reservoir, and discharges direct to the atmosphere at C, 3.8m below the free surface at A. The length of the pipe L, from A to B is 7.5 m and the length of pipe from B to C is 15m. Both the entrance and exit of the pipe are sharp and the value of F is 0.08. Calculate:
3. The mean velocity of the water leaving the pipe at C. (4 marks)
4. The pressure in the pipe at B (4 m arks)

Take loss coefficient at entrance, K = 0.5

1. Two sharp ended pipes of diameter  and each of length, are connected in parallel between two reservoirs which have difference of level as shown in the figure (iv) below. If the Darcy coefficient  for each pipe, calculate:
2. The rate of flow for each pipe. (6 marks)
3. The diameter of a single pipe 120m long which would give the same flow if it was substituted for the original two pipes (4 marks)

Take loss coefficient at entrance K=0.5