MACHAKOS UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING

DEGREE OF BACHELOR OF SCIENCE

END OF SEMESTER I YEAR II EXAMINATIONS MAY 2019

ECV 207 FLUID MECHANICS II

Time 2 HOURS

Answer QUESTION ONE AND ANY OTHER TWO Questions

1. (a) Explain what is meant with the following terms. (5 marks)
   i. Small orifice
   ii. Large orifice
   iii. Coefficient of contraction
   iv. Coefficient of velocity
   v. Coefficient of discharge

   (b) Derive experimentally an expression for the Coefficient of Velocity, C_v. (10 marks)

   (c) An external mouthpiece used to convey water converges from the inlet up to the vena contracta to the shape of the jet, and then diverges gradually. The diameter at the vena contracta is 20 mm and the head over the centre of the mouthpiece is 1.44 m. The head loss in the contraction may be taken as 1% and that in the divergent portion as 5% of the total energy head before the inlet. By assuming that the pressure in the system is permitted to fall up to 8 m below atmospheric, find
   (a) The maximum discharge that can be drawn through the outlet. (10 marks)
   (b) The corresponding diameter at the outlet (5 marks)

2. (a) State types of losses encountered when a liquid flows through a pipe. Give also their examples. (6 marks)

   (b) Derive an expression for the loss of head due to friction in a pipeline in terms of the velocity head, assuming that the frictional resistance per unit area of pipe wall is proportional to the square of the mean velocity of flow. (10 marks)

   (c) Find the loss of head due to friction in a pipe 300 m long and 150 mm diameter when the discharge is 2.73 m^3/min and the resistance coefficient, f = 0.01. (4 marks)

3. (a) What are the considerations made by Manning and Hazen-Williams when proposing a modification of the Darcy-Weisbach formula for the loss of head due to friction in flow through pipes? (6 marks)

(b) What are the forms of energy which a flowing fluid possesses? (3 marks)

(c) Two water reservoirs, the surface levels of which differ by 20 m are connected by a pipe system consisting of a sloping pipe at each end 9m long and 80mm diameter and joined by a horizontal pipe 400mm diameter and 72m long. Taking frictional coefficient, $f = 0.005(1 + \frac{25}{d}$, where d is the pipe diameter in millimeters, determine the discharge through the pipe. (11 marks)

4. (a) What is an equivalent pipe? (2 marks)

(b) What are the considerations made when describing an equivalent pipe and a compound pipe? (4 marks)

(c) Derive Dupit's equation in connection with equivalent and compound pipes explaining each parameter (4 marks)

(d) Three pipes of lengths 800 m, 400 m and 200 m and diameters of 0.6 m, 0.4 m and 0.2 m respectively. These pipes are to be replaced by an equivalent pipe of length 1400 m. Assuming the friction factor of the compound pipe to be the same,

(i) Determine the equivalent diameter of the equivalent pipe. (5 marks)

(ii) The equivalent length of a 300 mm equivalent diameter pipe (5 marks)

5. The figure below shows a sketch of a rectangular layout of simple pipe network with loads. Assuming a frictional coefficient, f of 0.005, gravitational acceleration, g as 9.81m/s^2, diameter of all pipes as 30 cm except AC which is 45 cm, and Darcy-Weisbach general equation for loss of head due to friction in pipes,

(i) Calculate the r values

(ii) Distribute the flow in the network (20 Marks)