THE TECHNICAL UNIVERSITY OF KENYA

FACULTY OF ENGINEERING SCIENCES & TECHNOLOGY

SCHOOL OF INFRASTRUCTURE AND RESOURCE ENGINEERING

DEPARTMENT OF CIVIL & CONSTRUCTION ENGINEERING

END OF SEMESTER 1 YEAR 3 EXAMINATIONS DECEMBER 2018 SERIES

DEGREE OF BACHELOR OF TECHNOLOGY- CIVIL ENGINEERING

EECI 3131 HYDRAULICS IIA

TIME 2 HOURS

Answer ANY THREE 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. (5 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. (7 marks)
   (b) The corresponding diameter at the outlet (3 marks)

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

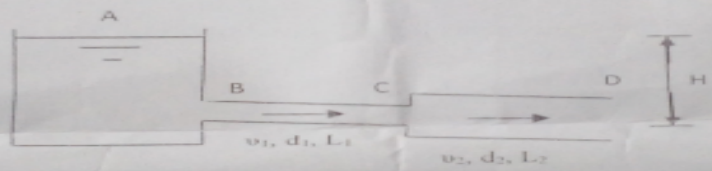
   (b) Derive an expression for the loss of head due to friction in a pipeline in terms of the velocity head, assuming that the frictional resistance per unit area of pipe wall is proportional to the square of the mean velocity of flow. (10 marks)

(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) Apply Bernoulli's equation to points A and D in the figure below, and derive an expression for the total energy at point A. (4 marks)

(c) In the figure below, water is discharged from reservoir A into the atmosphere through a pipe 39 m long. There is a sharp entrance to the pipe and the diameter is 50 mm for 15 m from the entrance. The pipe then enlarges suddenly to 75 mm in diameter for the remainder of its length. Calculate the difference of level between the surface of reservoir A and the pipe exit D which will maintain a flow of 2.8 dm^3/sec. Take f as 0.0048 for the 50 mm pipe and 0.0058 for the 75 mm pipe. (10 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 $9.81 m/s^2$, 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)