



MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 207 FLUID MECHANICS II

DATE: 26/7/2019

TIME: 2.00-4.00 PM

INSTRUCTIONS: Answer questions **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
 - i. The maximum discharge that can be drawn through the outlet. (10 marks)
 - ii. 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 $2.73 \text{ m}^3/\text{min}$ 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. a) What causes water hammer during flow of liquids in pipes? How can the occurrence of water hammer be reduced? (4 marks)
- b) Derive from first principles an expression for the pressure head or inertia head due to increase in pressure when a valve is gradually closed. (10 marks)
- c) In a pipe 600 mm diameter and 300 m length provided with a valve at its end, water is flowing with a velocity of 2 ms^{-1} . Assuming velocity of pressure wave C is 1500 ms^{-1} , find the rise in pressure (in kNm^{-2}) if the valve is closed in 20 seconds. (6 marks)