(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2019/2020 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR TECHNOLGY (BUILDING AND CONSTRUCTION)

COURSE CODE: BTB 323

COURSE TITLE: HYDRAULICS

DATE: MONDAY 13TH JANUARY 2020 TIME: 3.00 – 5.00 PM

INSTRUCTIONS:

1. This paper contains FIVE Questions
2. Answer FOUR Questions only
3. Marks for each question are indicated in the parenthesis.
4. It is in the best interest of the student to write legibly
5. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE

a) If the discharge in a channel of width 5 m is 20 m^3/s and Manning's n is 0.02 find:

i) The normal depth and Froude number for a streamwise slope of 0.001

ii) The state of flow **[8 marks]**

b) A concrete lined has base width of 5 m and the sides have slopes of 1:2. Manning's n is 0.015 and the bed slope is 1:1000: Determine the discharge, mean velocity and the Reynolds Number when the depth of flow is 2 m. Also, state the flow regime. Take viscosity of water as 0.001 Ns/m^2 and density as 1000 kg/m^3 **[8 marks]**

c) Define the following terms **[4 marks]**

i) steady flow ii) sub-critical flow iii) super-critical flow iv) critical flow

QUESTION TWO

a) Outline the characteristics of rapidly varied flow **[4 marks]**

b) A sluice gate at the base of a large reservoir is raised 1.7 m, as shown Fig. Q2, and the water discharges through this 5.0 m-wide rectangular orifice into a rectangular channel of the same width. If a hydraulic jump forms in the channel, what will be its height? **[8 marks]**

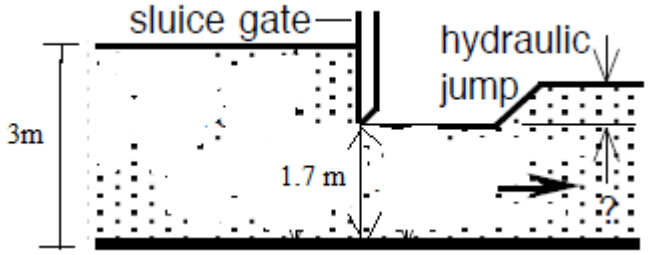

Fig. Q2

c) A rectangular channel with a bottom width of 4.0 m and a bottom slope of 0.0008 has a discharge of 1.50 m^3/sec. In a gradually varied flow in this channel, the depth at a certain location is found to be 0.30 m. assuming n = 0.016, determine the type of gradually varied flow profile **[8 marks]**

QUESTION THREE

a) A wide (the depth is much smaller than the width) rectangular channel has a slope S = 0.02. The bed and walls of the channel are paved with concrete. The value of Manning's roughness coefficient is n = 0.014 and the discharge per unit width of the channel is q = 3 m^2/s. Find the depth and velocity of the flow. Is the slope steep or mild? **[8 marks]**

b) Determine the maximum discharge of water through a circular channel of diameter 1.5 m when the bed slope is 1 in 900 and Chezy's C = 50 **[8 marks]**

c) Using a suitable diagram, explain the concept of alternate depths **[4 marks]**

QUESTION FOUR

a) Water flows at a depth of 10 cm in a rectangular channel 3 m wide with a flow rate of 2 m^3/s. Is the flow subcritical or supercritical? What is the alternate depth? **[6 marks]**

b) Determine the rate of flow through a pipe of diameter 20 cm length 50 m when one end of the pipe is connected to a tank and the other open to the atmosphere. The pipe is horizontal and the height of water in the tank is 5 m from the centre of the pipe. Minor losses are to be included and $f = 0.004$ **[8 marks]**

c) A single cylinder single acting reciprocating pump has a piston diameter of 400 mm and stroke length of 450 mm. When the pump runs at 45 rpm, it discharges 0.039 m^3/s under a total head of 15 m. What will be the volumetric efficiency, work done per second and power required if the mechanical efficiency of the pump is 75% **[6 marks]**

QUESTION FIVE

a) A double acting reciprocating pump, running at 45 rpm is discharging 1.5 m^3 of water per minute. The pump has a stroke of 450 mm. The diameter of the piston is 250 mm. The delivery and suction heads are 25 m and 5 m, respectively. Find the slip of the pump and power required to drive the pump **[6 marks]**

b) The length and diameter of a suction pipe of a single acting reciprocating pump are 5 m and 15 cm respectively. The pump has a piston of diameter 20 cm and a stroke length of 35 cm. The centre of the pump is 4 m above the water surface in the pump. The length and diameter of the delivery pipe are 30 m and 10 cm, respectively and water is delivered by the pump to a tank 25 m above the centre of the pump. The atmospheric pressure is 10.3 m H_2O. If the pump is running at 35 rpm, determine; **[14 marks]**

i) Pressure head due to acceleration at the beginning of the suction stroke

ii) Maximum pressure head due to acceleration at the suction pipe

iii) Pressure head in the cylinder at the beginning and at the end of the suction stroke

iv) Pressure head due to acceleration at the beginning and end of delivery stroke.