(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2019/2020 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 352

COURSE TITLE: HYDRAULICS

DATE: TUESDAY 3RD NOVEMBER 2020 TIME: 9.00 – 11.00 AM

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 4 Printed Pages. Please Turn Over.

QUESTION ONE

a) Find the rate of flow and conveyance for a rectangular channel 7.5 m wide for uniform flow at a depth of 2.25 m. The channel is having bed slope as 1 in 1000. Take Chezy's constant C = 55. Also determine the state of flow [6 marks]

b) Determine the most economical section of a rectangular channel carrying water at the rate of 0.5 m^3/s; the bed slope of the channels being 1 in 2000. Take n = 0.012 [5 marks]

c) A concrete channel of bottom width 5 m and side slopes 1:2 and roughness coefficient n = 0.013 is developed into the following section (Fig Q1) in order to withstand flood conditions. When the flow goes over the top of the trapezoidal channel it moves to the flood plains so the section allows for a lot more discharge to be carried. If the flood channels are 10 m wide and have side slopes of 1:3 and the manning roughness coefficient n = 0.025. Find the discharge for a flood level of 4 m. Take the slope of the channel as 0.001 [9 marks]

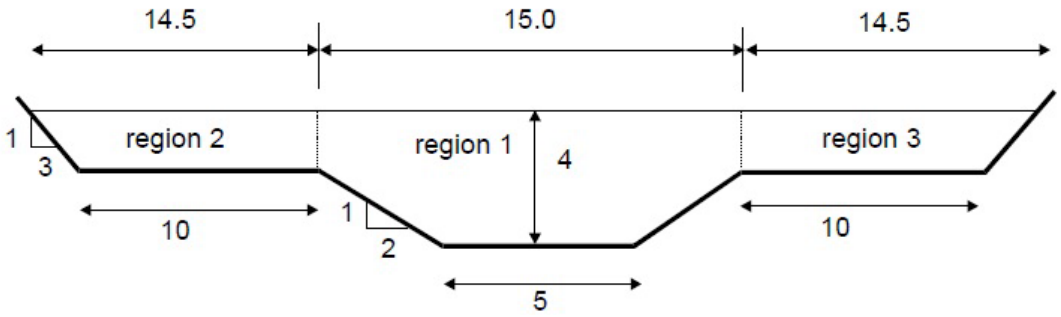

Fig Q1

QUESTION TWO

a) If the discharge in a channel of width 4 m is 20 m^3/s and Manning's n is 0.015, find: [10 marks]

(i) the normal depth and Froude number for a streamwise slope of 0.01
(ii) the critical depth
(iii) the critical slope

b) Water flows with a velocity of 2 m/s and at a depth of 3 m in a rectangular channel. Determine the change in depth and in water surface elevation produced by;

(i) gradual upward change in bottom elevation (upstep) of 60 cm
ii) gradual downstep of 15 cm
(iii) what is the maximum size of upstep that could exist before upstream depth changes would result?

Neglect head losses [10 marks]

QUESTION THREE

a) A hydraulic jump is situated in a 4 m wide rectangular channel. The discharge in the channel is 7.5 m^3/s and the depth upstream of the jump is 0.2 m. Determine:

(i) The upstream Froude number
(ii) The depth downstream of the jump
(iii) The downstream Froude number
(iv) The head loss in the jump [8 marks]

b) In a trapezoidal channel of bottom width 24 m, depth of flow 6 m and side slopes 3V:1H, the rate of flow of water is 86.4 m^3/s. If the bed slope of the channel is 1 in 4000 find the slope of the free water surface. Take n = 0.015 [8 marks]

c) Using illustrations, differentiate among C1, S1, M1, C3, M3 and S2 [4 marks]

QUESTION FOUR

a) A single cylinder single acting reciprocating pump has a piston diameter of 400 mm and stroke length of 500 mm. When the pump runs at 50 rpm, it discharges 0.035 m^3/s under a total head of 20 m. Determine

(i)The volumetric efficiency
(ii) work done per second and
(iii) Power required if the mechanical efficiency of the pump is 75% [6 marks]

b) A double acting reciprocating pump operating at 120 r.p.m. has a piston diameter of 200 mm and stroke of 300 mm. The suction and delivery heads are 4 m and 20 m, respectively. If the efficiency of both suction and delivery strokes is 75 percent, determine the power required by the pump [4 marks]

c) A Pelton wheel is to be designed for the following specification:

Shaft power = 12000 KW
Head = 350 m
Speed =750 rpm
Overall efficiency = 86 %
Jet diameter is not to exceed one sixth of the wheel diameter.

Determine

(i) Wheel diameter
(ii) Number of jets required
(iii) Diameter of jet

Take coefficient of velocity is 0.985 and speed ratio 0.45 [10 marks]

QUESTION FIVE

a) The piston diameter and stroke length of a double-acting single cylinder reciprocating pump are 150 mm and 300 mm respectively. The centre of the pump is 4.5 m above the water level in the sump and 32 m below the delivery water level. Both the suction and delivery pipes have the same diameter of 75

mm and are 6 m and 36 m long respectively. If the pump is working at 30 r.p.m. determine:
(i) The pressure heads on the piston at the beginning, middle and end of both suction and delivery strokes,
(ii) The power required to drive pump if the mechanical efficiency is 80%,
Take atmospheric pressure head = 10.3 m of water, and Darcy's friction co-efficient for both the pipes as 0.01. [16 marks]

b) A centrifugal pump running at 750 r.p.m. discharges water at 0.1 m^3/s against a head of 10 m at its best efficiency. A second pump of the same homologous series, when working at 500 r.p.m., is to deliver water at 0.05 m^3/s at its best efficiency.
(i) What will be the design head of the second pump and
(ii) What is the scale ratio between the first and the second [4 marks]