(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATIONS 2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

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

COURSE CODE: **BTB 323/CSE 352**

COURSE TITLE: **HYDRAULICS**

DATE:5TH AUGUST 2022 **TIME: 8 A.M – 10 A.M**

INSTRUCTIONS:

1. This paper contains FOUR Questions
2. Answer Question One and any other two questions
3. Marks for each question are indicated in the parenthesis.
4. It is in the best interest of the candidate 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 [Compulsory] (30 Marks)

Figure Q1 is a composite and compound channel cross-section with main and floodway parts. Its longitudinal bottom slope is S_b=0.0085.The normal water depth within the main part is y = 2.135 m and within the floodway is y = 83 cm. Calculate:
a) The amount of discharge passing within this channel b) the state of flow
c) The existing specific energy within this channel d) the critical depth of this cross-section e) the minimum energy of this cross-section f) the alternate depth of this cross-section

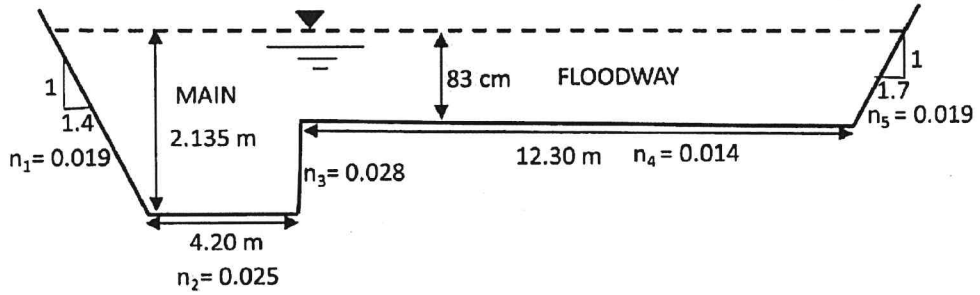


Figure Q 1

QUESTION TWO [20 Marks]

a) A lined trapezoidal channel has one side vertical and the other one having as slope 1:1. The channel has to deliver 8 m^3/s when laid on a slope of 0.0002. What would be the dimensions of the efficient section which requires minimum lining? Take n = 0.015 [10 marks]
b) A circular pipe 0.80 m in diameter conveys a discharge at a depth of 0.30 m. if the pipe is laid on a slope of 1 in 900, estimate the discharge of this channel. Take n = 0.015 [10 marks]

QUESTION THREE [20 Marks]

a) A rectangular channel 2.4 m wide carries uniform flow of 7 m^3/s at a depth of 1.5 m. If there is a local rise of 0.15 m in bed level, calculate the change of water surface elevation [8 marks]
b) A trapezoidal channel with a base of 6m and side slope of 2H: 1V conveys water at 17 m^3/s. Is the flow situation sub critical or supercritical [8 marks]
c) A gear pump has a 75 mm outside diameter, a 50 mm inside diameter, and a 25 mm width. If the actual pump flow at 1800rpm and rated discharge is 0.105 m^3/min, what is the volumetric efficiency? [4 marks]

QUESTION FOUR [20 Marks]

a) Explain the occurrence of water hammer in pipes [5 marks]

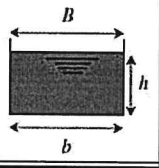
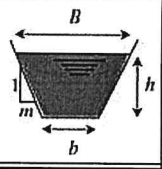
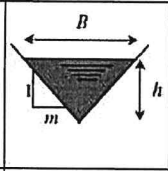
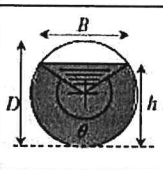
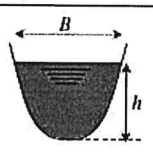
b) The length and diameter of a suction pipe of a single acting reciprocating pump are 5 m and 15 cm respectively. The pump has a piston of diameter 20 cm and a stroke length of 35 cm. The centre of the pump is 4 m above the water surface in the pump. The length and diameter of the delivery pipe are 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 H2O. If the pump is running at 35 rpm, determine; [15 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

FORMULAE SHEET

	rectangular	*trapezoidal*	*triangular*	*circular*	*parabolic*
					
flow area A	bh	$(b+mh)h$	mh^2	$\frac{1}{8}(\theta-\sin\theta)D^2$	$\frac{2}{3}Bh$
wetted perimeter P	$b+2h$	$b+2h\sqrt{1+m^2}$	$2h\sqrt{1+m^2}$	$\frac{1}{2}\theta D$	$B+\frac{8}{3}\frac{h^2}{B}$ *
hydraulic radius R_h	$\frac{bh}{b+2h}$	$\frac{(b+mh)h}{b+2h\sqrt{1+m^2}}$	$\frac{mh}{2\sqrt{1+m^2}}$	$\frac{1}{4}\left[1-\frac{\sin\theta}{\theta}\right]D$	$\frac{2B^2h}{3B^2+8h^2}$ *
top width B	b	$b+2mh$	$2mh$	$\frac{(\sin\theta/2)D}{2\sqrt{h(D-h)}}$ or	$\frac{3}{2}\frac{Ah}{}$
hydraulic depth D_h	h	$\frac{(b+mh)h}{b+2mh}$	$\frac{1}{2}h$	$\left[\frac{\theta-\sin\theta}{\sin\theta/2}\right]\frac{D}{8}$	$\frac{2}{3}h$

$P = 2r\theta$	$\Delta P = \rho cu$
$A = r^2\theta - \frac{r^2 sin2\theta}{2} = r^2\left(\theta - \frac{sin2\theta}{2}\right)$	$h_2 = \frac{-h_2}{2} + \sqrt{\frac{{h_1}^2}{4} + \frac{2q^2}{gh_1}}$
$n_{eq} = \sqrt{\frac{n_i^2 P_i}{\sum P_i}}$	$\frac{1}{\lambda} = -2.10\log_{10}\frac{K_s}{3.7D} + \frac{2.51}{R_e\sqrt{\lambda}}$
$E = h + \frac{V^2}{2g}$	$c = \sqrt{\frac{K}{\rho}}$