MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2022/2023 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION

COURSE CODE: **BTB 323**

COURSE TITLE: **HYDRAULICS**

DATE: 19TH DECEMBER 2022 **TIME: 12- 2 P.M.**

INSTRUCTIONS:

1. This paper contains FOUR Questions
2. Answer Question ONE and any other TWO Questions only
3. Marks for each question are indicated in the parenthesis.
4. It is in the best interest of the candidate to write legibly
5. Formulae Sheet is provided at the end of the question paper
6. 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)

a) Describe the difference between uniform and non-uniform flow [4 marks]
b) Water at 20°C is flowing uniformly in a wide rectangular channel at an average velocity of 2 m/s. If the water depth is 0.2 m, determine whether the flow is laminar or turbulent. Take density of water as 1000 kg/m^3 and viscosity μ =1.793 x 10^{-3} kg/m.s [4 marks]
c) Water is flowing steadily in a 0.4-m-wide rectangular open channel at a rate of 0.2 m^3/s. If the flow depth is 0.15 m, determine the flow velocity, state of flow, specific energy, critical depth, minimum specific energy and the alternate depth [12 marks]
d) Water is flowing uniformly in a rectangular open channel with unfinished concrete surfaces. The channel width is 6 m, the flow depth is 2 m, and the bottom slope is 0.004. Taking n = 0.014;
i) Determine discharge and unit discharge in the channel [5 marks]
ii) The type of GVF at a location where the flow depth is 2.5 m [5 marks]

QUESTION TWO (20 Marks)

a) Water discharging into an 8-m-wide rectangular horizontal channel from a sluice gate is observed to have undergone a hydraulic jump. The flow depth and velocity before the jump are 1.2 m and 9 m/s, respectively. Determine
(i) The flow depth and the Froude number after the jump [6 marks]
(ii) The head loss and the dissipation ratio, and [4 marks]
(ii) The power dissipated by the hydraulic jump. [3 marks]
b) Two pipes are connected in parallel between two reservoirs that have difference in levels of 3.5 m. The length, the diameter, and friction factor (f) are 2400 m, 1.2 m, and 0.001for the first pipe and 2400 m, 1 m, and 0.002 for the second pipe. Determine the discharge through the pipes and the total discharge. Neglect minor losses [7 marks]

QUESTION THREE (20 Marks)

a) Water flowing in a wide channel encounters a 22-cm-high bump at the bottom of the channel. If the flow depth is 1.2 m and the velocity is 2.5 m/s before the bump, determine if the flow is choked over the bump, and discuss [10 marks]
b) Water (density of 1000 kg/m^3, bulk modulus of 2.2 GPa) is flowing at 1.2 m/s in a pipe when the flow is suddenly halted.
i) Assuming the walls of the pipe are sufficiently thick for it to be approximately rigid, find the speed of water hammer waves and the pressure rise [4 marks]
ii) If the pipe is flexible and has a wall thickness of 5 mm and pipe diameter is 100 mm, determine the speed of water hammer waves and the pressure if the pipe material is steel (E = 210 GPa) and PVC (E = 2.6 GPa). [6 marks]

QUESTION FOUR (17½ Marks)

a) A horizontal pipe of 75 mm diameter is joined by sudden enlargement to a 125 mm diameter pipe. Water is flowing through it the rate of 2 m^3/min. find

i) Loss of head due to abrupt expansion [5 Marks]

(ii) Pressure difference in two pipes, and [3 marks]

(iii) Change in pressure if the change of section is gradual without any loss [2 marks]

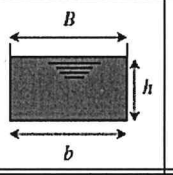
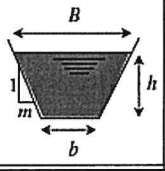
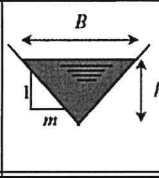
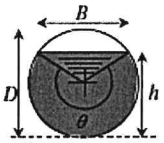
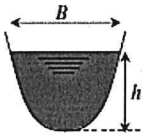
b) A smooth concrete-lined channel has trapezoidal cross-section with base width 6 m and sides of slope 1V:2H. The bed slope is 1 in 500 and the normal depth is 2 m. Take C = 50

i) Calculate the quantity of flow. [4 marks]

ii) If the quantity of flow in the above channel is 40 m^3/s, what is the normal depth? [6 marks]

END OF QUESTION PAPER

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	$b+2mh$	$2mh$	or $\frac{(\sin\theta/2)D}{2\sqrt{h(D-h)}}$	$\frac{3}{2}\frac{Ah}{}$
hydraulic depth D_h	h	$\frac{(b+mh)h}{b+2mh}$	$\frac{1}{2}h$	$\left[\frac{\theta-\sin\theta}{\sin\theta/2}\right]\frac{D}{8}$	$\frac{2}{3}h$

$P = 2r\theta$	$\Delta P = \rho cu$
$A = r^2\theta - \frac{r^2 sin2\theta}{2} = r^2\left(\theta - \frac{sin2\theta}{2}\right)$	$h_2 = \frac{-h_2}{2} + \sqrt{\frac{{h_1}^2}{4} + \frac{2q^2}{gh_1}}$
$n_{eq} = \sqrt{\frac{n_i^2 P_i}{\sum P_i}}$	$\frac{1}{\lambda} = -2.10\log_{10}\frac{K_s}{3.7D} + \frac{2.51}{R_e\sqrt{\lambda}}$
$E = h + \frac{V^2}{2g}$	$c = \sqrt{\frac{K}{\rho}}$
$h_2 = \frac{h_1}{2}\left(-1 + \sqrt{1+8Fr_1^2}\right)$	$\frac{1}{K'} = \frac{1}{K} + \frac{D}{Et}$