(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 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: MONDAY 25TH APRIL 2022 TIME: 12.00 – 2.00 PM

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. Formulae sheet is provided at the end of the Question paper
5. It is in the best interest of the candidate to write legibly
6. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE [Compulsory] (30 Marks)

A rectangular channel whose bottom width is 4.0 m carries a discharge of Q = 3 m^3/sec, having Manning roughness coefficient of n = 0.02 and the channel bottom slope is S_0=0.004.

a) Compute the normal and critical depth [8 marks]

b) Classify the flow regime using Froude Number, flow depth and channel bed slope [7 marks]

c) Obtain the specific energy of this reach [4 marks]

d) Calculate minimum specific energy [2 marks]

e) Obtain the alternate depth [4 marks]

f) Draw the specific energy curve for the above discharge [5 marks]

QUESTION TWO [20 Marks]

a) For a depth of 5 m in the symmetrical compound section shown in Fig. Q2. Assume the flood plains and the main channel have the same bottom slope of 0.001, and Manning n for the main channel and for the floodplain are 0.021 and 0.039 respectively. Determine the discharge through the compound channel [14 marks]

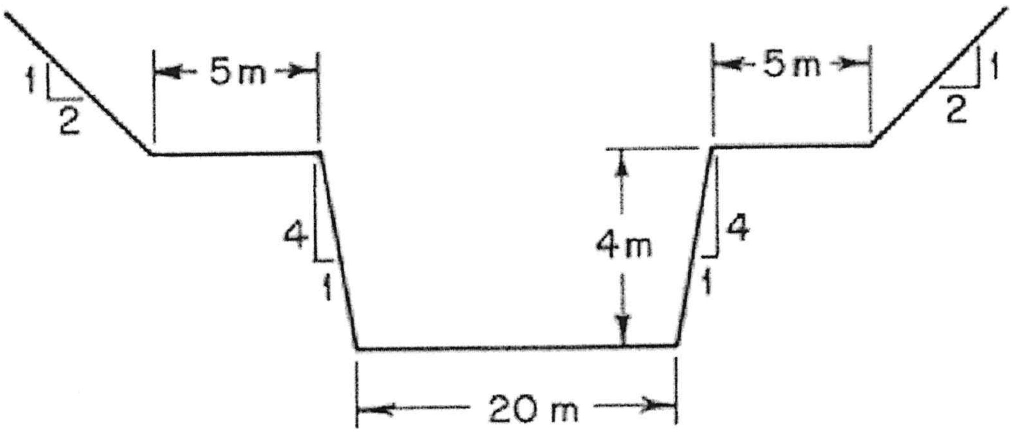


Figure Q2

b) A spillway has a discharge of 1.2 m^3/s per m width occurring over it from a reservoir 5 m high. What depth will exist downstream of the hydraulic jump? Assume negligible losses over the spillway [6 marks]

QUESTION THREE **[20 marks]**

a) A concrete lined circular channel of 2 m diameter has a bed slope of 1 in 1000. Determine the flowrate and velocity for i) maximum discharge condition ii) maximum velocity condition. Take C = 50 [10 marks]

b) A weir is installed across a rectangular open channel thereby raising the flow depth from 1.2 m in a normal flow to 2 m at the weir. The width of the channel is 15 m and it is laid to a slope of 1 in 10000. Find an approximate length of the backwater curve considering the average velocity, average depth and average slope midway between the two sections. Take n = 0.012. [10 marks]

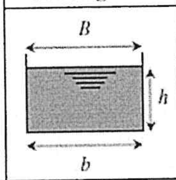
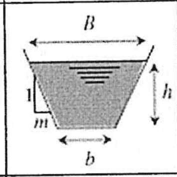
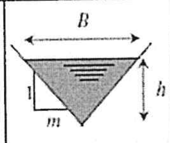
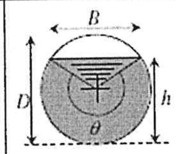
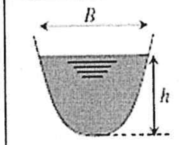
QUESTION FOUR **[20 marks]**

a) Water is flowing in a pipe of 150 mm diameter with a velocity of 2·5 m/s when it is suddenly brought to rest by closing the valve. Find the pressure rise assuming pipe is elastic, E = 206 GN/m^2, Poisson's ratio = 0·25 and bulk modulus for water = 2·06 GN/m^2. Pipe wall is 5 mm thick [4 marks]

b) A single-acting reciprocating pump, running at 60 rpm., delivers 0.53 m^3 of water per minute. The diameter of the piston is 200 mm and stroke length 300 mm. The suction and delivery heads are 4 m and 12 m respectively. Determine: (i) Theoretical discharge, (ii) Co-efficient of discharge, (iii) Percentage slip of the pump, and (iv) Power required to run the pump. [8 marks]

c) A horizontal pipe of 75 mm diameter is joined by sudden enlargement to 100 mm diameter pipe. Water is flowing through it at a rate of 3 m^3/min. Find the loss of head due to abrupt expansion and the pressure difference in the two pipes [4 marks]

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

* *Valid for* $0<\xi\le 1$ *where* $\xi=4h/B$

If $\xi>1$ *then* $P=(B/2)\left[\sqrt{1+\xi^2}+(1/\xi)\ln\left(\xi+\sqrt{1+\xi^2}\right)\right]$

$P=2r\theta$	$h_2=\frac{h_1}{2}\left(-1+\sqrt{1+8\mathrm{Fr}_1^2}\right)$
$A=r^2\theta-\frac{r^2\sin 2\theta}{2}=r^2\left(\theta-\frac{\sin 2\theta}{2}\right)$	$h_2=\frac{-h_2}{2}+\sqrt{\frac{h_1{}^2}{4}+\frac{2q^2}{gh_1}}$
$n_{eq}=\sqrt{\frac{n_i^2P_i}{\sum P_i}}$	$H_1-H_2=\frac{(h_2-h_1)^3}{4h_1h_2}$
$l=\frac{E_2-E_1}{S_0-S_e}$	$c=\sqrt{\frac{K'}{\rho}}$
$\frac{dy}{dx}=\frac{S_o-S_e}{\left(1-\frac{V^2}{gy}\right)}$	$\frac{1}{K'}=\frac{1}{K}+\frac{D}{Et}$
$E=h+\frac{V^2}{2g}$	$c=\sqrt{\frac{K}{\rho}}$
$\Delta P=\rho cu$	$\frac{1}{\lambda}=-2.10\log_{10}\frac{K_s}{3.7D}+\frac{2.51}{R_e\sqrt{\lambda}}$