Hydraulics 3 Coursework **AUTUMN 2023**

Submission deadline: Thursday 9th November 2023 (18.00pm GMT)
Coursework should be submitted via Blackboard as a single PDF file. It may be either typed or handwritten and scanned. **This must be entirely your own work.** No marks will be given if working is not shown, or if a scan is unreadable. Marks will be deducted for untidiness, excessive padding (e.g. repeating the question), inadequate working, units missing in final answers, non-single-PDF submission.

Question 1 (15 marks)

A rectangular channel is to be built to divert a river during dam construction. The lining of the channel is unfinished concrete with a Manning's $n = 0.014\ \mathrm{m}^{-1/3}\mathrm{s}$. The streamwise slope is 1 in 1000. If the channel has depth 0.6 m and has to carry a maximum discharge of $2.5\ \mathrm{m}^3\mathrm{s}^{-1}$, find the channel width required.

Question 2 (15 marks)

Water flows at $1.8\ \mathrm{m}^3\ \mathrm{s}^{-1}$ through a long rectangular drain of width 0.75 m and streamwise slope 1.5 %. The drain is characterised by a Chézy resistance coefficient $C = 70\ \mathrm{m}^{1/2}\ \mathrm{s}^{-1}$.

(a) Find the depth of flow in the drain.

At one point the drain opens out abruptly into a broader channel of width 2.4 m and smaller slope, causing an immediate hydraulic jump. Estimate:

(b) the depth of flow just downstream of the hydraulic jump;

(c) the power dissipated as a result of the transition.

Question 3 (20 marks)

Water runs down a long wide spillway ($n = 0.012\ \mathrm{m}^{-1/3}$ s and slope 1 in 50) onto a wide apron ($n = 0.015\ \mathrm{m}^{-1/3}$ s and slope 1 in 2000). The flow rate is $0.9\ \mathrm{m}^3\ \mathrm{s}^{-1}$ per metre width.

(a) Find the critical depth and the normal depths on the spillway and apron.

(b) Assuming no nearby downstream controls, use one step in the GVF equation to calculate the distance from the foot of the spillway to the hydraulic jump.