NATIONAL UNIVERSITY OF SINGAPORE

FACULTY OF ENGINEERING

EXAMINATION FOR

(Semester I: 2011-2012)

CE5312 - RIVER MECHANICS

Nov/ Dec 2011 - Time allowed: 2.5 hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains **THREE(3)** questions and comprises **THREE(3)** printed pages.

2. Answer **ALL** questions.

3. All questions carry equal marks.

4. This is an "**OPEN BOOK**" examination.

Question 1

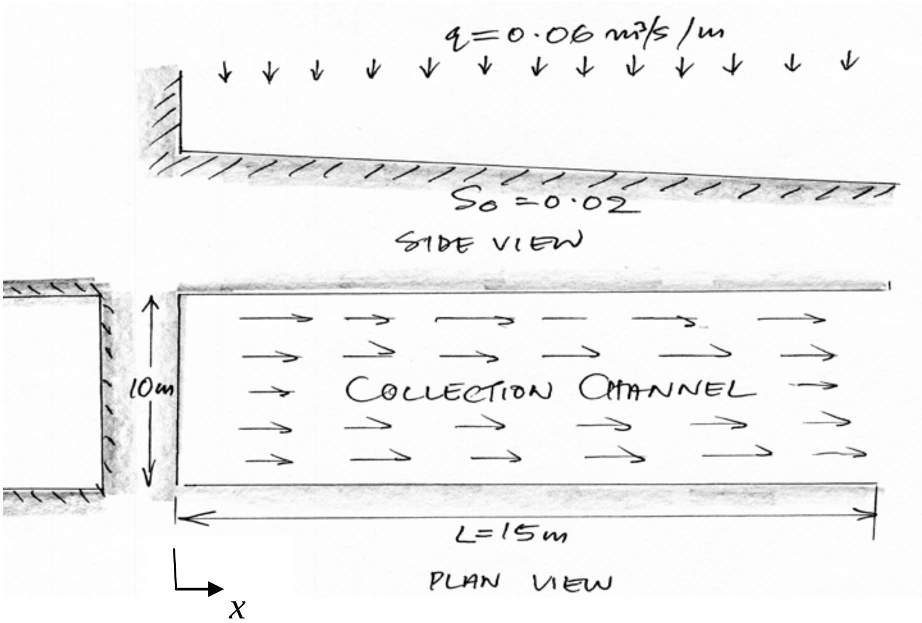

Fig. Q1

The collection channel of a cooling tower facility is rectangular in cross section with a length $L = 15\ m$ and a width $B = 10\ m$. The channel is built out of concrete with a Manning 'n' value of 0.013. A continuous stream of water droplets fall into the collection channel and the rate is $q = 0.06\ m^3/s/m$ length of the channel. (See Fig. Q1). The slope of the channel is $S_0 = 0.02$.

(a) Determine the position and magnitude of the critical depth. If the critical depth occurs in the channel, sketch the surface profile and indicate the regime of flow upstream and downstream of the critical section.

[15 marks]

(b) Hence, determine the maximum water level in the channel with a one step integration from the critical depth to the location in the channel where the depth of the water in highest. You may adopt any finite difference scheme for the one step integration.

[10 marks]

Show your working and state your assumptions clearly with explanations.

Hint: You may proceed by assuming the critical depth to occur at the end of the channel to obtain a first trial value of x_c and then perform only one more trial for x_c.

You may use the following equations in your computations.

$$x_c = \frac{8q^2}{gB^2\left(S_0 - \dfrac{gP}{BC_c^2}\right)}$$

$$U = C_c\sqrt{RS_f}$$

$$C_c = \frac{R^{1/6}}{n}$$

x_c = location of the section where the flow is critical and x is measured downstream from the upstream end of the channel
P = wetted perimeter
R = hydraulic radius
U = average cross sectional flow velocity
S_f = frictional slope
g = gravity

Question 2

You are designing a relief channel for a large lake. The channel has a rectangular section of width $B = 6$ m and lined with concrete for which the Manning 'n' value is 0.014. The channel runs along a length of $L = 1200$ m and ends in an overfall where the invert level is set not less than 15 m above the datum. The channel is to carry a discharge of $Q = 24$ m^3/s and the lake level is not allowed to rise higher than 18 m above the datum.

Describe how you would go about deciding on the slope of the channel. [25 marks]

Question 3

A wide river discharges into the sea where the tidal range is 1.5 m and the tidal period is 12.5 hours. When the tide is at its mean sea level, the water depth at the river mouth is 5m. The initial river flow is uniform at 0.5 m/s when the tide starts to fall from its highest level. Assume that the river bed is horizontal and flow resistance is negligible as a first approximation.

It is desirable to determine the time history of the water depth at a location 'B' 2 km from the river mouth. Assume that the tide starts to fall at a reference time of $t = 0$.

(a) Justify with equations, outline the procedure for finding the time history of the water depth at location 'B'. [12 marks]

(b) Find the time when the water level at 'B' starts to fall. [5 marks]

(b) What is the water level at 'B' when $t = 2.54$ hrs ? [8 marks]

- END OF PAPER -