National Exams May 2016

04-ENV-B2, Water Resources

Maximum Time: 3 Hours

NOTES:

1. There are SIX (06) questions in this exam. Answer any FIVE (05) questions. The marks assigned to each question are shown in brackets beside the question. Maximum total marks = 100.
2. FIVE (05) questions constitute a complete exam paper. The first five questions as they appear in the answer book will be marked.
3. Each question is of equal value.
4. The examination is **CLOSED BOOK.**
5. Examination material consists of Four (04) pages including this page, exam problems and Crib sheet.
5. If doubt exists as to the interpretation of any question, or if you consider that there is missing information, the candidate is urged to make a reasonable assumption and submit a clear statement of any assumptions made with the examination paper.
6. The use of an electronic calculator is permitted. Candidates may use one of two calculators, the Casio or Sharp approved models. User-prepared programs, user stored information or program cards are strictly forbidden.
7. The use of cell phones is prohibited during the exam.

Problem 1 (20):

a. Define Water Resources Sustainability. Mention minimum of six facts that should be considered in Water Resources Sustainability (10)
b. Describes challenges to Water resources sustainability (10)

Problem 2 (20):

Removal of pollutants from Stormwater before discharging into receiving waters is governed by Federal and Provincial Regulations. Describes at least Five legislation that deals with Water Resources and Stormwater Management.

Problem 3 (20):

a. Name three hydrologic models (softwares) used for Stormwater modeling in Ontario and one hydraulic model used for flood management system in Ontario (05)

b. Design Storm Sewers for proposed street in new subdivision with drainage area A1 (0.7 ha) and A2 (0.5 ha) having runoff coefficient of 0.45. Area A1 flows into Area A2 and Area A2 flow into an outlet. Another words, area A1 is upstream of area A2 and the flows from area A1 flows into area A2. Therefore storm sewer for Area A2 should be design to accommodate flows from both A1 and A2. Design the storm sewers for the 5-year storm event using Time of Concentration (Tc) of 12 minutes and the 5-Year Intensity Duration Frequency (IDF) Parameters without causing flooding on the street. The 5-Year IDF Parameters are provided as:

5-Year IDF Parameters

A	B	c
1330.31	7.938	0.855

Assume Manning's roughness co-efficient of 0.013 for the proposed storm sewers and slope of 2%. (15)

Problem 4 (20):

a. What is return period used for flood predication. Define the one in hundred year flood event (05)
b. A river flow through the downtown area of the city. The 100-year flood elevation is required to establish limit of development to avoid flooding if happened. Find 100-year flood water surface elevation for100-year flow of 129 m^3/sec. The bottom width of the river is 12 m and the side slope is 2.5:1. Assume Manning's roughness coefficient of 0.026 and slope of the river is 1%. The elevation of the bed of the river is 239 m.(15)

Problem 5 (20):

a. Define the following terms related to Groundwater (08).

i. Soil Water Zone;
ii. Intermediate Zone;
iii. Capilary Zone; and
iv. Saturated Zone.

b. Water flows through a sand aquifer with a piezometric head gradient of 0.01. (a) If the hydraulic conductivity and effective porosity of the aquifer are 2 m/d and 0.3, respectively, estimate the specific discharge and seepage velocity in the aquifer; (b) estimate the volumetric flow rate of the groundwater if the aquifer is 15 m deep and 1 km wide. (c) How long does it take the groundwater to move 100 m? (12)

Problem 6 (20):

a. What is Algae bloom. (5)
b. Mention urban sources of phosphorous that may contribute to Algae bloom in the Lake Erie (10)
c. Describes measures required to minimise the effects of the urban phosphorous to stop Algae bloom in the Lake Eric.(5)

CRIB SHEET FOR 04-ENV-B2, December 2014 EXAM

1. Equation of Flow = QV

2. $V = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$

   Where
   R = Hydraulic Radius
   S = Slope

3. Q = CIA

   Where:
   C = runoff co-efficient
   I = Rainfall Intensity (mm/hour)
   A = Drainage area (ha)

4. $I = \frac{A}{(B + Tc)^C}$

   Where:
   I = Rainfall Intensity (mm/hour)
   A,B,c = IDF Parameters
   Tc = Time of Concentration