UNIVERSIDADE PRESBITERIANA MACKENZIE
ESCOLA DE ENGENHARIA
ENGENHARIA CIVIL

Curricular component: **Exclusive Course (X)** Common Axis ( ) Universal Axis ( )		
Course: **Civil Engineering**		Thematic Core: **Environment & Water Resources**
Name of Curricular Component: **Applied Hydrology**		Code of Curricular component:
Workload: (3)	(0) Classroom (3) Laboratory (0) EaD	Stage: 7th stage

Catalog Description:

Introduction to engineering hydrology. Environmental impacts resulting from human activities and infrastructure development, their influence on the hydrological cycle and the critical role of engineers in sustainable water management. Watershed and water balance. Elements of the hydrologic cycle and hydrologic measurement. Hydrological processes: precipitation, evaporation and transpiration, infiltration and soil water movement, runoff processes. Extreme precipitation and precipitation frequency analysis. Flood frequency analysis. Urban storm drainage system. Hydrologic design for flood control. Hydrologic design for water use.

Objectives:

Conceptual Objetives	*Procedural Objetives and Skills*	*Attitudinal Objectives and Values*
Learn the fundamental laws of surface water hydrology and how to apply these laws in hydrologic design and analysis. Understand the main components of the hydrologic cycle and their interrelationships, such as rainfall, infiltration, evaporation, and runoff. Learn main statistical and probabilistic methods used in hydrologic design.	Explain the hydrologic cycle and key processes. Interpret hydrologic measurement data. Apply engineering design to produce solutions for stormwater systems, flood control and water use. Understand the environmental impacts resulting from human activities and infrastructure development, their influence on the hydrological cycle and the critical role of engineers in sustainable water management.	Become aware of the need for continuous and systematic study, and of the importance of permanent engagement in the teaching-learning process. Act autonomously and recognize the need for personal commitment and effort both inside and outside the classroom. Work and engage in group discussions. Value and take interest in theoretical foundations to support critical thinking and decision-making. Maintain a correct attitude regarding attendance, participation and attention to classes, avoiding parallel conversations and maintaining focus on content. Respect the start and end times of a class.

Program content:

1. Introduction to Hydrology & Water Resources
   - Role of hydrology within civil/environmental engineering
   - Functions of water resources systems (supply, energy, flood control)
   - Human impacts on the hydrologic cycle

2. Watershed, Water Balance & Hydrological Cycle
   - Watershed definition, delineation, and physical characteristics
   - Continuity equation and water balance components
   - Elements of the hydrologic cycle and hydrologic measurement

3. Precipitation Measurement & Analysis
   - Types of precipitation
   - Rain gauges & radar rainfall
   - Spatial averaging methods (Thiessen polygons, isohyets)

4. Evaporation & Transpiration
   - Energy and mass transfer concepts
   - PET estimation

5. Infiltration & Soil Moisture
   - Soil properties, infiltration capacity
   - Models: Horton, Green-Ampt

6. Runoff Processes & Hydrologic Response
   - Surface vs subsurface runoff
   - Unit hydrograph concept
   - Rational method

7. Extreme Precipitation & Frequency Analysis
   - Probable Maximum Precipitation (PMP)
   - IDF curves, return periods
   - Probability distributions

8. Flood Frequency Analysis
   - Annual maxima vs POT series

9. Urban Hydrology & Storm Drainage
   - Imperviousness effects
   - Storm sewer design: Rational Method, time of concentration
   - Detention vs retention

10. Hydrologic Design
    - Hydrologic Design for Flood Control
    - Hydrologic Design for Water Use

Methodology:

The syllabus content will be developed as follows:

- **Lectures:** conducted to enable the organization and synthesis of the knowledge presented.
- **Recommended readings:** assigned to provide students with opportunities for (a) consulting specific bibliography related to the course and (b) developing their analytical, synthesis, and critical skills.
- **Guided assignments:** carried out individually or in small groups, aimed at encouraging the student's active participation in the learning process, providing opportunities to (a) present and discuss topics related to the course and (b) develop critical and argumentative abilities.
- **Audiovisual resources:** learning will be supported through materials made available in advance on the Moodle virtual environment.

Evaluation criteria:

According to the Academic Regulations (ATO A-RE-27/2020):

Art. 50. The assessment of academic performance shall be calculated as follows:

I. **Semester Average (MS)**: corresponds to the average of the Intermediate Grades (N1 and N2), weighted by their respective weights that sum to 10 (ten), to which the Participation Score (PS) may be added, as follows:
   a) with PS: MS = [(N1 × weight N1 + N2 × weight N2) / 10] + PS, with PS ranging from 0 to 1; and
   b) without PS: MS = [(N1 × weight N1 + N2 × weight N2) / 10], with PS ranging from 0 to 1.

II. **Final Average (FA)**: reflects the final result of academic performance, being:
   a) the same as the Semester Average when it is equal to or greater than 6 (six); or
   b) the arithmetic mean of the Semester Average and the Final Evaluation Score, when the Semester Average is lower than 6 (six).

When calculating the Semester Average and the Final Average, only the first decimal place of the grade is considered, following standard rounding rules for the second decimal place.

Art. 51. A student in an in-person program will be considered approved if they obtain:

I. a minimum attendance of 75% of the total course workload; and
II. a Final Average equal to or greater than 6.0 (six).

N1 includes a written exam (AA1) and a group project (P1),
$N1 = 0.80 \times AA1 + 0.20 \times P1$

N2 includes a written exam (AA2), a group project (P2), and a general evaluation exam (AVI),
$N2 = 0.60 \times AA1 + 0.20 \times P1 + 0.20 \times AVI$

The Semester Average (MS) is computed as follows:
$MS = 0.40 \times N1 + 0.60 \times N2$

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Main references:

COLLISCHONN, W.; DORNELLES, F. Hidrologia para Engenharia e Ciências Ambientais. Porto Alegre: Associação Brasileira de Recursos Hídricos (ABRH), 2013.
HENSEL, D.R.; HIRSCH, R.M.; RYBERG, K.R.; ARCHFIELD, S.A.; GILROY, E.J. Statistical Methods in Water Resources. Reston: U.S. Geological Survey. 2020.
MARGULIS, S. A. Introduction to Hydrology. 4. ed. Long Grove, IL: Waveland Press, 2017.

Additional references:

BRUTSAERT, W. Hydrology: an introduction. 2. ed. Cambridge: Cambridge University Press, 2023.
DAVIE, T. Fundamentals of hydrology. 3. ed. New York: Routledge, 2019.
DINGMAN, S. L. Physical hydrology. 2. ed. Upper Saddle River, NJ: Prentice Hall, 2002.
MAYS, L. W. Water resources engineering. 2. ed. Hoboken, NJ: John Wiley & Sons, 2010.
VIESSMAN JUNIOR, W.; LEWIS, G. L. Introduction to hydrology. 5. ed. Upper Saddle River, NJ: Prentice Hall, 2002.

Course Coordinator:	**Unit Director:**
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