ROMBLON STATE UNIVERSITY
College of Engineering and Technology
Department of Civil Engineering

CE 315 – HYDROLOGY
1st Semester SY 2020-2021

"Water is the most critical resource issue of our lifetime and our children's lifetime. The health of water is the principle measure of how we live on the land."
- Luna Leopold

INTRODUCTION

Dear Students:

Welcome to this course, CE315 HYDROLOGY!

With the current situation, we are experiencing a "new normal" in the delivery of higher education in the country.

Every student should watch the Student Virtual Orientation SY 2020-2021 that was aired via Facebook last September 11, 2020. The video presentation is available in the official Facebook page of Romblon State University or click this link: https://www.facebook.com/RomblonStateUniversity/videos/320989219129054. At the same time, the College of Engineering and Technology also presented a live streaming of its online orientation held on September 14, 2020 and please watch again for its recorded video at: https://www.facebook.com/rsucetwhitewolves/videos/913465115844625. If these links are not working properly, every student should visit the FB official pages of the RSU and CET to look for these videos, including latest news and updates.

As part of the comprehensive continuity and flexible learning plan of the university in time of pandemic, there are different learning strategies to be implemented to ensure equal opportunity of quality education through flexible learning modalities for the students. One of these modalities is the online/e-learning that involves the use of learning systems and platforms available in the digital world.

Specifically, in the delivery of this course CE315 HYDROLOGY, the primary mode of delivery of instruction is through the internet using the free and public domains powered by Google Classroom and Weebly. Other optional domains to be utilized are Canvas, Moodle and ARAL particularly in giving major examinations and discussion forums. Please note however that connectivity is a big challenge for faculty and students, but "flexibility" in terms of compliance with the requirements towards completion of the course will be extended. However, this flexibility will be extended to those students who have really experiencing difficulties during the duration of the course.

Please take note of the following links specifically for this course:

www.rsucivilengineering.weebly.com

https://classroom.google.com/u/3/c/MTU1Njc3MTkwMzI4
Class code: a7iu47l

www.aral.cloud.8000

https://rsu2020.moodlecloud.com/

Please read carefully the syllabus and course outlines for better apprehension of the course. Handouts and other instructional/reading materials will be uploaded in these websites on a weekly basis. It is expected that every student should download and read these materials. E-files or hard copies are available upon request and students are responsible for having them photo copied or printed. Special arrangements will be done on case-to-case basis. And most importantly, please take note of the rules and policies for conduct of the course.

HANDOUT #1
CE315 Hydrology

1. Difference of Hydrology and Hydraulics/Fluid Mechanics

HYDRAULICS is a branch of scientific and engineering discipline that deals with the mechanical properties of fluids, mainly water. It is applied in water resources, harbor and port, bridge, building, environment, hydropower, turbines, etc. It also refers to motion of fluids from the basic laws of physics – conservation laws of mass, momentum and energy. Conservation of mass: mass can be neither created nor destroyed. Conservation of energy – energy can be neither created nor destroyed; Conservation of momentum – a body in motion cannot gain or lose momentum unless some external force is applied.

Properties deals in Hydraulics include: density, specific gravity, viscosity, shear stress, pressure

2. What is Hydrology

HYDROLOGY is a branch of scientific and engineering discipline that deals with the occurrence, distribution, movement and properties of the waters of the earth. Knowledge of hydrology is fundamental to water and environmental professionals particularly in the design and operation of water resources, wastewater treatment, irrigation, flood risk management, navigation, pollution control, hydropower, ecosystem modelling.

Hydro = relating to water; loge (Greek) = knowledge

In reality, hydrology deals with the study of fresh water, because saline water on earth is carried out by oceanography. In a broader field of hydrology, it also covers the science of meteorology – phenomena of heart, water, and air movement, including climate and weather. This is related to those concerned with effective use of soil and water, wherein weather is often the controlling factor in problems of preventing excessive movement of soil, or retaining needed water, of increasing the intake of surface water, of adding needed water by irrigation and of removing excess water drainage.

HYDROLOGY is a science that deals with of the waters of the Earth, their occurrence, circulation, and distribution, their chemical and physical properties, and their reaction with their environment, including their relation to living things (Scientific Hydrology, US Federal Council for Science and Technology, June 1962)

Integration of the physical processes of hydrology with human interaction (quantity and quality issues) with freshwater

It is an applied science which comes from engineering and geography (earth science – land forms (geomorphology – to understand the spatial links between the processes). The engineering approach i more of finding solutions to problems posed by water moving around the earth.

3. Hydrologic or Water Cycle

It represents the pathways where water travels as it circulates throughout global systems by various processes. The visible components of this cycle are Precipitation and Runoff. Other components such as evaporation, infiltration, transpiration, percolation groundwater recharge, interflow, and groundwater discharge.

Water is available in the atmosphere, the oceans, on land and within the soil and rocks of the earth's crust. Water molecules from one location to another are driven by the solar energy. Moisture circulates from the earth into the atmosphere through evaporation and then back into the earth as precipitation (rainfall/rainwater).

Hydrologic or water cycle describes the continuous movement of water on, above and below the earth surface. This cycle involves the following key processes:

(a) *Precipitation (P)*: condensed water vapor that falls to the earth surface. Some precipitations forms are rain, snow, hail, sleet, drizzle, etc.

(b) *Runoff or Surface runoff (Q)*: variety of ways by which water moves across the land which includes both surface and channel runoff.

(c) *Infiltration or subsurface runoff/flow (Qc)*: the flow of water from the ground surface into the ground, consequently becomes soil moisture or ground water. Subsurface runoff when the flow of water underground, in the vadoze zone and aquifers which returns to the surface as springs or seep into the oceans and seas, or land surface at lower elevation due to gravity.

(d) Evaporation and transpiration:

(e.1) *Evaporation* is the process of liquid converting into water vapor (gas), through wind action and solar radiation and returning to the atmosphere.

(e.2) *Transpiration* is the process by which water molecules leaves the body of a living pant and escapes to the atmosphere.

(e.3) *Evapo-transpiration* includes all evaporation from water and land surfaces, as well as transpiration from plants.

The estimated volumes of water held at the earth's surface as shown below. It can be observed that most of the earth's water is in the oceans and fresh water is only a small proportion of the total water (2.5%) mainly stored in the ice.

	Volume ($\times 10^3$ km^3)	***% of total***	***% of fresh water***
Oceans and seas	1,338,000	96.54	-
Ice caps and glaciers	24,064	1.74	69.6
Groundwater	23,400	1.69	30.1
Permafrost	300	0.022	-
Lakes	176	0.013	0.3
Soil	16.5	0.001	0.05
Atmosphere	12.9	0.0009	0.04
Marsh/wetlands	11.5	0.0008	0.03
Rivers/Streams	2.12	0.00015	0.006
Biota	1.12	0.00008	0.003
Total	**1,385,984**	**100.00**	
Freshwater	**35,029**	**2.5**	**100.00**

Source: Dawei Han (2010), Concise Hydrology; Tim Davie (2002), Fundamentals of Hydrology

4. Importance and Utilization of Water

Knowledge of hydrology is basis for the development of water supply systems. Salinity problems in agriculture also evidence of the lack of hydrologic principles of water management; locations of costly developments in flood plains of large river systems. Better understanding of hydrology, can help determine how and to what extent the cycle can be modified by human activity in practical way. For example large-scale irrigation systems increase soil water content, evaporation, and crop use of water. A practical knowledge of hydrology will help the decision-maker and general public understand the overall effect of human's influences on the hydrologic cycle and the side effects of projects on other people, their activities and the environment. Thus, informed decision-maker will be able to weigh the advantages of each proposed change in the hydrologic cycle against the disadvantages.

- Water is essential for life. The use of water by man, plants, and animals is universal. Without water can be no life.
- Man can live nearly two months without food, but can live only three or four days without water. Man himself is 80 percent water.
- Water is essential for the maintenance and improvement of health and sanitation of the community.
- Water is a principal raw material for food production and metabolic processes.
- Water provides man with some means of recreation, such as boating, hunting, swimming and fishing.
- Water protects life and property against fire.
- Water is employed in various industrial processes, power generation and also for navigation and transportation of goods and people.
- Water plays an important role in balancing the ecological system - the relationship between living things and the environment in which they live.

Water conservation and sanitation are important. The use of water is rapidly increasing due to growing population and urbanization. Shortage of both surface and groundwater is some areas in the country. Illegal and unregulated construction of deep wells also contributed in land sinking, consequently caused the lowering of water table. The lowering of fresh water (lakes, rivers) levels cause salt intrusion or salt water in the some coastal areas which ruined wells. In addition, uncontrolled pollution and contamination of the river systems and underground sources have greatly impaired the water quality. Thus, depletion of water supply is inevitable which requires better means of replenishing its supply to meet the increasing demand.

Major Purposes/Uses of Water

- Domestic/residential: for household needs such as drinking, food preparation, bathing, washing clothes and dishes, flushing of toilets, watering of plants (gardens and lawns).
- Commercial: for hotels/motels, restaurants, office buildings, other commercial facilities and institutions.
- Irrigation: artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth in recreational lands such as parks and golf courses.
- Industrial: for industrial purposes such as fabrication, processing, washing, and cooling.
- Livestock: for livestock watering, feed lots, dairy operations, fish farming, and other on-farm feeds.
- Mining: for extraction of minerals occurring naturally and associated with quarrying, well operation, milling, and other preparations at the mine site.
- Public: for the public purposes such as firefighting, street washing, municipal/town parks, and swimming pools.
- Rural: for suburban or farm areas for domestic and livestock needs and this is generally self-supplied type.
- Thermoelectric power: for the process of the generation of power.

Classification of fresh surface water (rivers, lakes, reservoirs)

Classification	Beneficial Use
Class AA	Public water supply class I. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines
Class A	Public Water Supply Class II. For sources of water supply that will require complete treatment (coagulation, sedimentation, filtration, and disinfection) in order to meet the NSDW.
Class B	Recreational Water Class. For primary contact recreation such as bathing, swimming, ski diving, etc. (particularly those designated for tourism purposes).
Class C	(1) Fishery Water for the propagation and growth of fish and other aquatic resources; (2) Recreational Water Class II (boating, etc.); and (3) Industrial Water Supply Class I (for manufacturing processes after treatment).
CLASS D	Navigable waters

5. **Climate of the Philippines – It covers modified coronas classification of climate type; primer on tornado, storm surge, floods, tropical cyclone, and rainfall warning system. Refer to the separate handout.**

6. **Weather Instruments – It covers the basic weather parameters and instruments used, instruments that measure temperature, atmospheric pressure, surface wind velocity and direction, atmospheric humidity, and other special instruments. Refer to the separate handout.**

GUIDE QUESTIONS

These questions will provide you achieve the learning outcomes for the topics presented. Eventually, these questions will assist you in remembering the important lessons that will be used in accomplishing your homework/assignment.

a. Why hydrology is offered in the civil engineering curriculum?
b. What are the major processes in the hydrologic or water cycle?
c. What are the significance contributions of these processes in the managing our water resource?
d. What the classifications and their uses of surface water?
e. What is the difference between climate and weather?
f. What are primary instruments that are commonly used in weather monitoring?
g. What climatic condition that the Province of Romblon classified?
h. In what ways we can contribute in sustaining the supply and use of water in our homes and communities?

SUGGESTED READING RESOURCES:

Brutsaert, W. (2005). Hydrology An Introduction, UK: University Press, Cambridge.

Davie, T. and Quinn, N.W. (2019). *Fundamentals of Hydrology*, New York: Routledge.

Davie, T. (2008). *Fundamentals of Hydrology*, Taylor & Francis e-Library.

Davis, M. L. And Masten, S.J. (2004). *Principles of Environmental Engineering and Science*, International Edition, New York: McGraw-Hill Education (Asia).

Eslamian, S. (2014). *Handbook of Engineering Hydrology, Environmental Hydrology and Water Management*, UK: Taylor & Francis Group, LLC.

Han, Dawei (2010). *Concise Hydrology*, Dawei Han and Ventus Publishing APS, Retrieved from www.bookboon.com.

Henry, J.G. and Heinke, G.W. (2000). *Environmental Science and Engineering*, Singapore: Pearson Education Asia Pte., Ltd., Singapore.

Raghunath, H.M. (2006). *Hydrology: Principles, Analysis, Design*, Revised Second Edition, New Delhi, India: New Age International (P) Limited, Publishers.

Mihelcic, J.R. and Zimmerman, J.B. (2010). *Environmental Engineering Fundamentals, Sustainability, Design*, Singapore: John Wiley & Sons Singapore Pte, Ltd.
Shaw, E.M. (2005). *Hydrology in Practice*, Third Edition, UK: Taylor & Francis or Routledge, www.ebookstore.tandf.co.uk.
Speight, J.G. and Lee S. (2000). *Environmental Technology Handbook*, 2nd Edition, USA: Taylor & Francis, USA.
Subramanya, K. (2008). *Engineering Hydrology,* 3rd Edition, New Delhi: Tata McGraw-Hill Publishing Company Limited.
Schwab, G., Fangmeier, D., Elliot, W., Frevert, R. (1993*). Soil and Water Conservation Engineering*, 4th Edition, Quezon City: JMC Press, Inc.
The World Bank Office Manila (2012). *Rural Water Supply Design Manual, Volumes 1-3,* Water Partnership Program, Manila, Philippines: World Bank.
Vesilind P.A, Morgan, S.M., and Heine, L.G. (2013). *Introduction to Environmental Engineering*, 1st Philippine reprint, Singapore: Cengage Learning Asia Pte Ltd.

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