UNICUSANO
ROME

Italian Code: ICAR/02 (old) , CEAR 01-B (new) **Credits: 9**
Matter: Hydraulic works
Main language of instruction: Italian
Other language of instruction: English

Teaching Staff

Head instructor
prof. Silvia Di Francesco - silvia.difrancesco@unicusano.it

Introduction

1. *Objective of the course :*

The course offers the fundamental concepts and operational tools for the design of the hydraulic works most frequent in civil engineering: aqueducts and urban drainage systems. The educational goal of the course is also to provide the student with a knowledge of the main hydrological processes of a river basin and the mathematical models that describe their behavior.
The e-tivities associated with the course develop the skills necessary to deal with classic problems of river basin analysis, sizing and verification of water supply, drainage and distribution works.

Objectives

2. *Course Structure:*

The course is organized in 3 main subjects: Hydrology, aqueducts, drainage systems. The "virtual classroom" forum includes 4 Etivity which foresee the application of the knowledge, acquired in theory lessons, to the solution of problems typical of hydrology and applied hydraulics. The Etivity allow students to acquire skills and competencies in calculation software: Excel, Epanet, QGis.

Competencies:

A. Knowledge and understanding: At the end of the course, the student knows the fundamental characteristics of hydrological modeling, of the works for the collection and removal of wastewater and rainwater from the urban territory and of the works for the supply and distribution of drinking water resources.

B. Applying knowledge and understanding: The student will be able to use the knowledge of hydrological processes and the design and management criteria of hydraulic infrastructures for their analysis and sizing:

- Analysis and modeling of watersheds
- assessment of water resources
- Estimation of needs
- Design of drinking water supply works
- Design of pipeline systems for transport and distribution
- Analysis and management of existing water networks
- design of urban drainage networks

Through the Etivity students will acquire the ability to formulate problems of hydraulic constructions with the help of specific engineering software.

C. Making judgements: The student will be able to identify the most appropriate models to describe and simulate problems of hydrology and hydraulic infrastructures.

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D. Communication skills: The student will develop the ability to use a correct scientific language that allows to express in a clear and unambiguous way the technical knowledge acquired in the field of modeling, design and verification problems of hydrological processes and hydraulic systems.

E. Learning skills: At the end of the course, the student will have knowledge of the fundamental notions necessary for the analysis of hydrological-hydraulic problems. The course will provide him the basis to be able to learn new methodologies and computational techniques proposed by the technical literature and specific calculation software.

Syllabus

3. *Programme of the course:*

Part I: Hydrology

Subject 1. The hydrological cycle at the basin scale

Topics: Historical notes on hydraulic constructions, The hydrological cycle, The hydrographic basin, The hydrological balance of a basin

Subject 2. Rainfall

Topics: Rainfall Genesis, Rainfall Observations, Rainfall Regimes, Areal Precipitation Distribution, Measurement Systems

Subject 3. Statistical rainfall analysis

Topics: statistical elements, statistical inference, project rainfall, project hyetographs

Subject 4. Flood runoff

Flood runoff formation, Hydrometric measurements, Speed measurements, Flow rate scale, Flow rate regime, Flow formation mechanisms, Flood hydrograph components

Subject 5. Losses from Rainfall and Rainfall Excess

Interception, depression storage, and soil-moisture replenishment, Infiltration losses, infiltration models

Subject 6. Rainfall- runoff models

Classification of hydrological models, linear models, IUH.

Subject 7. Flood models

Rational formula, Giandotti method, Kinematic model, Linear reservoir model Elementary models, Nash model, Clark model, Instant Geomorphological Unitary hydrographs

Part II: Aqueducts

Subject 8. Water needs

Topics: Uses of water, Quantitative characteristics, Variability of consumption, Qualitative characteristics of the request for civil use, Water drinking judgment.

Subject 9. Water (catchment) uptake

Topics: groundwater works, springwater works, surface water works

Subject 10. Water supply

Topics: Water supply schemes, free surface and pressurized layouts and paths.

Subject 11. Design and analysis of water adduction systems

Topics: Project flows, hydraulic modeling, sizing and verification.

Subject 12 Storage reservoirs

Topics: Classification, control room, head and end tanks, hydraulic sizing of the storage tanks.

Subject 13 Distribution network

Topics: Network with head and terminal tank. Verification of pipeline networks: open and closed networks, Newton-Raphson method.

Subject 14 Pumping stations

Topics: Economic sizing, Selection criteria for centrifugal pumps, series and parallel operation, Characteristic curve of the system and operating point, Criteria for the construction of pumping stations

Subject 15 Materials

Topics: Earth and lined canals, cement and metal pipes, equipment and products

Part III Drainage networks

Subject 16 Sewerage systems
Topics Sewerage systems, Project flows, groundwater sewer entry, inflow-outflows simulation models in urban area
Subject 17 Hydraulic modeling and sizing
Topics: pipes, degradation phenomena, hydraulic calculations, path and profiles
Subject 18 Artifacts
Artifacts, Inspection wells, Confluences, Connections, Washing wells, Energy sinks, Liftings, crossings.

Evaluation system and criteria

The exam consists in a written test and a series of activities (E-tivity) carried out during the course in virtual classes.
E-tivity are evaluated from 0 to 6 points, while 0-24 points are assigned at the written test to be done at the Rome office or at the educational poles upon booking by the student.

The written test normally includes:
• 2 numerical exercises/ theoretical question concerning hydrology
• 3 theoretical questions/ numerical exercises on the main topics covered in the aqueducts and drainage systems modules.
Particular attention in the evaluation of the answers given is put on the student's ability to solve the numerical problem and to rework the material on the platform. During the written test, it is NOT allowed to use handouts, notes, texts or forms in paper or digital format. Use of the calculator is only permitted in the case of non-scientific or programmable calculators

Bibliography and resources

4. *Materials to consult:*

The educational material, provided by the teacher and available on the platform, is divided into 18 modules. They entirely cover the program; each of them contains lecture notes, slides and video lessons in which the teacher comments on the slides. This material contains all the elements necessary to deal with the study of the subject.

5. *Recommended bibliography:*

James Chwen-Yuan Guo Urban Hydrology and Hydraulic Design, Water Resources Publication, 2006 - 507 pages

Ram S. Gupta, Hydrology and Hydraulic Systems: Fourth Edition, Waveland Press, 7 set 2016 - 888 pages

Dragan Savic, John K. Banyard, Water Distribution Systems, ICE Pub., 2011 - 342 pagine