UNICUSANO
ROME

Code: ICAR/02 **Credits: 9**
Matter: Hydraulic works
Main language of instruction: Italian
Other language of instruction: English

Teaching Staff

Head instructor
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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:

- knowledge of the fundamental characteristics of hydrological modeling
- Knowledge of the works for the collection and drainage of wastewater and rainwater from the urban territory
- Knowledge of the works for the supply and distribution of the drinking water resource.

- Knowledge of the methods for the evaluation of water inflows and outflow
- Knowledge of sizing and verification procedures for adduction, distribution systems and drainage works.

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 18-19 Artifacts

Artifacts, Inspection wells, Confluences, Connections, Washing wells, Energy sinks, Liftings, crossings.

Subject 20- 21 Project examples

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 21 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