UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

HYDROLOGY

Enrollment year	2018/2019
Academic year	2020/2021
Regulations	DM270
Academic discipline	ICAR/02 (MARITIME HYDRAULIC CONSTRUCTION AND HYDROLOGY)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL AND ENVIRONMENTAL ENGINEERING
Curriculum	Ingegneria civile
Year of study	3°
Period	2nd semester (08/03/2021 - 14/06/2021)
ECTS	6
Lesson hours	48 lesson hours
Language	Italian
Activity type	WRITTEN TEST
Teacher	PETACCIA GABRIELLA (titolare) - 6 ECTS
Prerequisites	MATHEMATICAL ANALYSIS: Concepts of function, limit, derivative, integral. Factorials, combinations. Concept of differential equation (particularly of linear constant coefficient differential equation). Concepts of multivariable function, partial derivative and partial derivative equation. Determination of the (unconditional) maximum of a one-variable and multivariable function. Computational skills: computation of simple derivatives and integrals and use of mathematical tables of limits, derivatives, integrals and definite integrals. GEOMETRY AND ALGEBRA: Basic elements of trigonometry. Elementary analytical geometry (in two- and three-dimension space). Concepts of linear and non-linear scale. Matrices and linear algebraic equation systems. Computational skills: elementary applications of trigonometry and geometry (computation of areas included). Graphic representation of functions, with both linear and non-linear (particularly logarithmic) scales. PHYSICS: Measurement of physical magnitudes and units of

measurement. Basic concepts on the states of aggregation of matter and on the physical properties of bodies (density, viscosity, capillary action). Basic concepts of thermodynamics: heat exchange, specific heat,heat of vaporization, heat of fusion, vapour tension, partial vapour pression. Principles of thermodynamics. Principle of conservation of mass and principle of conservation of energy. MATHEMATICAL PHYSICS: Scalars and vectors. Sum and difference of two vectors. Vector decomposition in plane and space. Scalar product and vector product. Vector nature of forces. moment of a force about a point and an axis. Composition of forces. Moments (of different orders) of an area. Centre of gravity and moment of inertia. Cardinal equations of statics and dynamics. COMPUTER SCIENCE: Preparing and modifying a file. Working with an executable program.

Learning outcomes

The course gives the notions necessary for solving the hydrological problems most commonly met with in the engineering practice: analysis of water availability and analysis of floods. The course also gives the elements of statistics necessary for designing waterworks in accordance with the chosen risk level.

Course contents

Lectures
(34 hours)

Introduction. Origin and classification of precipitation. Thunderstorms, hurricanes. The factors of the rainfall regime. The rainfall regimes in Italy.
Rain gauges. Tables of the Italian Hydrographic Service with rainfall observations. Computation of the rainfall volume over an area (with different methods).
Random variables, probability and axioms, non exeedance probability and probability density.
The hydrographic basin: definition and principal characteristics. Different types of runoff. Determination of the concentration time.
Probability distribution parameters, moments. Variables which are functions of random variables. Return period. Binomial distribution.
Basin losses and different forms of water storage. Depression storage (short description). Dalton's law. Evaporation factors and steady evaporation. Evaporimeters (short description). Different evaporation types (short description). Actual and potential evapotranspiration. Infiltration (short description).
The normal distribution and other continuous variable distributions.
The practical determination of basin losses.
The inference problem. Frequency, sample moments. Estimation of a probability distribution. Probability papers. Parameter estimation. Method of moments.
River stage and discharge. Staff gauges and continuous water-level recorders. Current meters. Discharge computation. Stage-discharge relations.
Statistical tests. Pearson's test of fit.
The runoff regimes in Italy. Tables of the Italian Hydrographic Service with staff-gauge readings. The flood hydrograph analysis.
Statistical analyses of floods: classification. At-site analyses. The probability distribution of the N-year maximum discharge.

Dependence of rainfall depth on duration and area.
Design hyetographs.
The rainfall-runoff process. Mathematical models and relations. The rational method. White-box and black-box models. The determination of the net rainfall and of the stormwater runoff.
Linear and stationary systems. The instantaneous unit hydrograph and its application to stormwater runoff models. Discretization of the instantaneous unit hydrograph.
Series and parallel connections of linear stationary models. The linear channel and the time-area model. The linear reservoir and the sewerage network model constituted by a linear reservoir. The Nash model.
The model determination: choosing model type and estimating parameters. The least squares method and the method of moments.
Presentation and comment of slides showing measuring instruments and methods.
Laboratories (in the informatic laboratory)
(20 hours)

Excercise n. 1. The determination of the return period for a given probabilty using the normal distribution.

Excercise n. 2: Characteristics of the hydrografic basin

Excercise n. 3:Determination of the hydraulic losses of a basin

Excercise n. 4:The determination of the peak discharge with an assigned return period by means of Gumbel's law and Lognormal law.

Excercise n. 5: Evaluation of the discharge of a river.

Excercise n. 6: Determination of a rainfall depth-duration-frequency curve.
Excercise n. 7: The determination of a rainfall depth-duration-frequency curve and of some design hyetographs.
Excercise n. 8:Pearson test
Excercise n. 9: Determination of the instantaneous unit hydrograph using linear channel and linear reservoir models; flood hydrograph computation.

Excercise n. 10: Determination of the instantaneous unit hydrograph using GIUH and corrivation models; flood hydrograph computation.

Excercise n. 11: Determination of the instantaneous unit hydrograph using paralle and series models; flood hydrograph computation.

Teaching methods

Lectures (hours/year in lecture theatre): 34
Practical class (hours/year in lecture theatre): 20
Practicals / Workshops (hours/year in lecture theatre): 0

Reccomended or required readings

The computer programs, the transparencies used for the lessons and the notes relevant to lessons and laboratories can be found in Kiro

	Chow, V.T., Maidment, D.R., Mays, L.W. Applied Hydrology. New York, Mc Graw-Hill Book Company, 1988. Linsley, R.K., Kohler, M.A., Paulhus, J.L.H. Applied Hydrology. New York, Mc Graw-Hill Book Company, 1949. Maione, U., Moisello, U. Elementi di statistica per l'idrologia. Pavia, La Goliardica Pavese, 1993. Moisello, U. Idrologia tecnica. Pavia, Medea, 2014.
Assessment methods	The final exam is written and is aimed at ascertaining the achievement of the educational objectives of teaching. The subject of the examination are the contents of the reference texts, the contents of the lectures and the lessons carried out in the computer lab.
Further information	The final exam is written and is aimed at ascertaining the achievement of the educational objectives of teaching. The subject of the examination are the contents of the reference texts, the contents of the lectures and the lessons carried out in the computer lab.
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile