UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

APPLIED HYDRAULICS

Enrollment year	2019/2020
Academic year	2020/2021
Regulations	DM270
Academic discipline	ICAR/01 (HYDRAULICS)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL AND ENVIRONMENTAL ENGINEERING
Curriculum	PERCORSO COMUNE
Year of study	2°
Period	2nd semester (08/03/2021 - 14/06/2021)
ECTS	6
Lesson hours	51 lesson hours
Language	Italian
Activity type	WRITTEN TEST
Teacher	SIBILLA STEFANO (titolare) - 3 ECTS PERSI ELISABETTA - 3 ECTS
Prerequisites	Mathematical Analysis: functions of one or more real variables, limits, derivatives, integrals. Physics: measurement of physical quantities and units of measure. Principles and fundamental equations of mechanics. Energy. The energy conservation principle. Mathematical physics: scalars and vectors. Fundamental elements of vector calculus. Geometry of the masses.
Learning outcomes	The "Applied Hydraulic" is the second module of "Hydraulics" course. In the "Applird Hydraulic" module, the student must acquire the concepts and operational tools needed to solve the hydraulic problems of steady motion in free surface flows running into artificial channels. The student must be able to qualitatively and numerically sketch the free surface profiles in natural or artificial open channels as a function of the boundary conditions which characterize the flow and of any singularities.

Course contents	Flow basic notions: the flow concept. Flow spatial and temporal characteristics. Continuity equations and momentum equations. Free surface flows geometrical characteristics Geometrical characteristics of free surface flows for cross section. Geometrical characteristics of free surface flows for longitudinal profiles. Representation of natural open channels geometry. Normal flow in free surface flow Normal flow. Free surface flow resistance and roughness coefficients. Flow rate versus normal depth. Flow rate versus normal depth for closed sections. Flow rate versus normal depth for composed sections. Verification and design problem under the condition of normal flow: graphical methods (specific and normalized flow rate versus normal depth) and numerical method (Bisection). Unstable normal flow (rapid flow). Free surface flows energetic characteristics Specific-energy considerations. Water depth versus specific-energy with constant flow rate. Flow rate versus water depth with constant specific-energy. Critical state. Open channel flow: mild, critical and steep slope. General considerations for the profiles of gradually varied flow Gradually varied flow equation. Gradually varied flow for five classes of channel slope (mild, critical, steep, horizontal and adverse), showing basic solution curves. Control sections. Composite-flow profiles: solution curves between two regimes Passing through the critical depth. Hydraulic jump. Total force. Water depth versus total force with constant flow rate. Flow rate versus water depth with constant total force. Hydraulic jump placement. Backwater profiles Backwater concept and its upstream/downstream propagation. Integration of the steady gradually varied flow equations in prismatic channel. Open channel flow singularity Abruptly varied flow considerations. Characteristic scale (singularities scale and scale of steady flow profile). Properly filleted steps on the bottom. Flow measurement and control by weirs. Flow over wide weirs. Filleted and abrupt lateral contractions. Hydraulic jump modeler: sharp-crested weirs/ broad-crested weirs. Backwater caused by the bridge piers.
Teaching methods	Lessons (hours per year in the classroom): 34 Exercises (hours per year in the classroom): 18
Reccomended or required readings	The lesson slides and the exercises solutions are available on KIRO Platform. Further investigations are available in:

	Citrini D., Noseda D. “Idraulica” Tamburini, Milano AA.VV. “Sistemi di fognatura-Manuale di progettazione” (Capitolo 12), CSDU-Hoepli
Assessment methods	The exam of "Applied Hydraulic" will be held in a written form. The positive result of the test (vote equal or greater than 18/30), if accepted by the student, will be used, with the result of the exam of “Hydraulics Fundaments”, for the final result of the Cours “Hydraulics” course.
Further information	==
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile