COURSE: Applied Hydraulics	
ACADEMIC YEAR: 2017-2018	
TYPE OF EDUCATIONAL ACTIVITY: F (free choice)	
TEACHER: dr. Domenica Mirauda/Marilena Pannone	
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Language: Italian and, if needed, English.	

ECTS: 3+3	n. of hours: 27+27	Campus: : Potenza Dept./School: School of Engineering Program: Civil Engineering	Semester: 1

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The course aims at transferring know-how about:
Steady flow of free surface streams, laboratory experiments for the estimation of flow rate in free surface streams. Unsteady flow of free surface streams. Potential flows and boundary layer. Derivation of the forces soliciting the bridge peers in river beds. Turbulence, k-ε model and related dispersion processes. Bed and suspended load transport, and interactions with the engineering constructions along a stream. Steady and unsteady groundwater flows. Free surface and confined aquifers. Filtration across soil dams.
The expected learning outcomes are represented by the capability of understanding, solving and discussing simple hydraulic problems by analytical, numerical or graphical methods, mainly in terms of interaction fluid/engineering constructions; the capability of organizing and performing laboratory experiments for the estimation of flow field and water discharge in free surface streams.

PRE-REQUIREMENTS

Passing the exams of Mathematical Analysis I-II, Physics I-II and Fluid Mechanics before beginning with the Applied Hydraulics classes is highly recommended.

SYLLABUS

Steady flow of free surface streams (8h theoretical lessons + 7h classroom tutorials).
Definition of the geometrical, kinematic and dynamic variables; flow and continuity equations; empirical relationships for the calculation of the drag coefficient; rating curves; flow profiles; hydraulic jump. Exercises on flow profiles for real cases.
Measurement of the water discharge in open channel flows (8h theoretical lessons).
Techniques and methods for the evaluation of the water discharge. Laboratory equipment and experiments for the estimation of water discharge in free surface streams.
Unsteady flow of free surface streams (4h theoretical lessons).
Definition of the geometrical, kinematic and dynamic variables. Flow and continuity equations. Analysis of flood wave propagation by numerical and graphical methods.
Subsurface flows (6h theoretical lessons + 3h classroom tutorials).
Definitions and general concepts. Filtrating tunnels, free surface and artesian wells. Potential flows: potential and

stream functions, hydrodynamic grid. Assessment of filtrating flow rate and under-pressures in the presence of fluvial barrages. Aquifers. Dupuit hypothesis. Filtration across soil dams. Phenomenon of suspended source. Unsteady subsurface flows. Exhaustion of a free surface aquifer by a topographic sill. Water level and pressure oscillations in the coastal aquifers.

Solid transport (8h theoretical lessons + 4h classroom tutorials).

General concepts and estimation of the bed load rate as a function of the main hydro-dynamical parameters. Stream turbulent core and its interaction with the suspended load transport mechanisms. K-ε model and related dispersion processes. Stochastic approach and practical evaluation of the suspended load rate.

Digging up of foundations by a stream on a cohesionless bed: involved hydrodynamic mechanisms and outline of the classical methods for the determination of the excavation depth. Determination of drag and lift forces acting on an obstacle lapped by uniform flow resorting to the method of the potential flows.

Boundary layer theory (6h theoretical lessons).

Laminar and turbulent wall boundary layer. Separation of the boundary layer due to the solid contours curvature and related static and dynamic effects. Shear and shape flow resistances. Total resistance on the bodies lapped by the stream as a function of the Reynolds number.

TEACHING METHODS

The course consist of 54 hours of teaching subdivided in lectures (40 h) and classroom tutorials (14 h).

EVALUATION METHODS

The aim of the examination is to verify the achievement of the educational goals.

The student will give the teacher a report about the homework carried out during the course. This report must be delivered to the teacher during the exam.

The exam consists in an oral examination. The test intends to evaluate the understanding of the course topics and the ability to link and compare the different approaches.

The homework will be discussed during the exam to assess the comprehension of methods and tools used by the student.

The final score depends for 25% on the homework and for the remaining part on the oral examination.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Lecture notes provided by the teachers.

Specific topics can be explored on the following textbooks:

D. Citrini, G. Noseda, Idraulica, Casa Editrice Ambrosiana – Milano.

A. Ghetti, Idraulica, Edizioni Libreria Cortina - Padova.

E. Marchi - A. Rubatta, Meccanica dei Fluidi, UTET- Torino.

INTERACTION WITH STUDENTS

At the beginning of the course, after the presentation of objectives, program and methods of verification, the teachers collect the list of students who intend to attend the course. The students provide their name, ID number and e-mail so that the teachers can send them by e-mail lecture notes and whatever is useful to prepare the exam.

Office hours: Tuesday 10:30 to 12:30 at Mirauda's office (5th floor School of Engineering) and Thursday 11:00 to 13:00 at Pannone's office (5th floor School of Engineering).

Additionally, the teachers are available every time to keep in touch with the students by e-mail or business mobile.
EXAMINATION SESSIONS (FORECAST)[1] 8/02/18, 22/02/18, 11/04/18, 14/06/18, 18/07/18, 19/09/18, 21/11/18
SEMINARS BY EXTERNAL EXPERTS YES □ NO □ x
FURTHER INFORMATION

[1] Subject to possible changes: check the web site of the Teacher or the Department/School for updates.