UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2019/2020
BACHELOR'S DEGREE (BSC)	BUILDING ENGINEERING, INNOVATION AND RETROFITTING
SUBJECT	HYDRAULICS AND HYDRAULIC PLANTS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50108-Edilizia e ambiente
CODE	20405
SCIENTIFIC SECTOR(S)	ICAR/01
HEAD PROFESSOR(S)	TERMINI DONATELLA Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	98
COURSE ACTIVITY (Hrs)	52
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**TERMINI DONATELLA** Monday 11:00 13:00 Stanza propria Tuesday 09:00 13:00 Stanza propria Wednesday 09:00 13:00 Stanza propria Thursday 09:00 13:00 Stanza propria Friday 11:00 13:00 Stanza propria

DOCENTE: Prof.ssa DONATELLA TERMINI

PREREQUISITES	mathematical analysis I, mathematical analysis II, Physics I, geometry
LEARNING OUTCOMES	Knowledge and understanding The student, at the end of the course, will have knowledge about methodologies to effectively solve the problems related to the fluid mechanics, with special regards to : 1) calculation of static and dynamic actions over parts of hydraulic systems and hydraulic networks of a building (e.g. valvs, sluice gates, ...), 2) to the knowledge of the flow resistance laws and the identification of the flow regime (e.g., laminar, turbulent) inside pipes of a hydraulic network, 3) to the knowledge and calculation of energy losses in hydraulic systems of a building 4) to the hydraulic problems of pumping stations, 5) dealing with negative relative pressure inside portions of pipes in hydraulic networks, with cavitation problem Applying knowledge and understanding The student will be able to design and verify various types of pipelines and hydraulic networks of the fluid-dynamic systems of a building, distinguish the best design choice for pumping plants, as well as the application of his knoledgw to practical engineering cases. Making judgments At the end of the course the student will be able to integrate knowledge and handle complexity, as well as to make judgments based on limited information. Communication skills The student will be able to properly communicate with language skills, both to expert or common level people, its conclusions as well as the underlying knowledge and rationale about issues related to the approach to the definition and development of hydraulic plants / networks. Learning skills The student will have developed those learning skills that let him to autonomously master issues such as the optimization of the resources used for the purpose of reducing uncertainty associated with the hydraulic plants / networks.
ASSESSMENT METHODS	Oral examination Evaluation criteria for the oral examination The oral test consists of an interview, in order to check that you have skills and knowledge disciplinary provided during the course. The evaluation is expressed in thirtieths. The questions, both open both semi-structured to test the results of learning provided for, will tend to occur: a) the knowledge captured; b) the processing capacity, c) have adequate display capacity on the course contents. The final evaluation will be formulated according the following graduation of knowledge of the student. Excellent 30-30 and praise, very good knowledge of the topics of the course, excellent properties of language, good analytical ability, the student is able to apply knowledge to effectively solve the problems proposed during the course. 26-29 Very Good. The student shows good command of the topics, full of language, the student is able to apply knowledge to solve the proposed problems 24-25 good. The studend shows basic understanding of the main topics, discrete properties of language, with limited ability to independently apply the knowledge to the solution of the proposed problems Satisfactory 21-23. The sudent has not fully mastered the main teaching subjects but it has the knowledge, satisfactory property language, poor ability to independently apply the knowledge acquired Sufficient 18-20. The student shows minimum basic understanding of the major teaching and technical language issues, very little or no ability to independently apply the knowledge acquired Insufficient. The student does not have an acceptable knowledge of the contents of the topics covered in the teaching
EDUCATIONAL OBJECTIVES	At the end of the course, the student, will aquire the understanding, knowledge and methodology to solve effectively the verification problems of hydraulic plant networks, verification and project of pumping plants and problems related to the operation of hydraulic machines in buildings. The student will also gain the knowledge of computational tools dedicated to processing and to the solution of problems of verification and project of hydraulic systems.
TEACHING METHODS	classroom lessons, classroom exercises

SUGGESTED BIBLIOGRAPHY	D. Citrini, G. Noseda - Idraulica - ed. Ambrosiana Milano, 1987 G. Alfonsi, E. Orsi - Problemi di Idraulica e Meccanica dei Fluidi - ed. Ambrosiana Milano, 1984 E. Marchi, A. Rubatta – Meccanica dei Fluidi – ed. Utet, Torino Y. A. Çengel, J. M. Cimbala – Fluid Mechanics, Fundamentals and Applications – Mc. Grow Hill ed., Higher Education Materiale didattico fornito dal docente durante il corso

SYLLABUS

Hrs	Frontal teaching
1	Physical properties of fluids (dynamic and kinematic viscosity, density, specific weight). Newtonian and non-Newtonian fluids. Rheological laws
1	The Cauchy's tetrahedron theorem. The stress tensor
3	Hydrostatic. Equation of the static equilibrium in local (indefinite) and global form. Stevin's law and the pressure diagram. Pressure measurement instruments (eg, simple, metallic, differential pressure gauge). Computation of static fluid action over over flat and curved surfaces. The components method for the calculation of fluid static action over a curved surface
1	Kinematics of fluids . Eulerian derivation rule. Local and convective (Lagrangian) derivatives. Trajectories and current lines. Definition of flow tube
2	Mass conservation equation (continuity equation) in local (indefinite) and global form
4	Ideal fluids. Equation of the dynamic equilibrium in local (indefinite) and global form. Euler equation. Pressure distribution for linear and non-linear currents (the effect of the pipe curvature). Bernoulli's theorem and Bernoulli's trinomium. Definition of the relative and absolute piezometric and total energy lines. Transitory starting of the motion inside a pipe.
5	Real fluids. Equation of the dynamic equilibrium (the Navier Stokes equations) in local form (indefinite) and in global form. Laminar flow regime and Hagen-Poiseuille law of velocity distribution inside a pipe. Drag action of the flow inside a pipe. Profile of viscous tangential stresses. Turbulence and equation of dynamic equilibrium in local (indefinite) and global form. Turbulent velocity profiles. Tangential stress profile and difference between viscous and turbulent tangential stresses
2	Local hydraulic energy losses (sharp widening - Borda, inlet, outlet). Trend of the piezometric and total energy lines.
4	Flow resistance laws. The wall tangential stress for laminar , fully turbulent and transition turbulent flow regime. The Reynolds number. Moody's Abacus and comparison with the Nikuradse's Harp. Identification of the flow regime inside a pipe.
1	Hydraulic pumps and turbines inside a flow current
2	Currents with negative prelative pressure. Cavitation related problems.
1	Transitory processes in pressurized pipelines. The water hammer. Computation of the overpressure for instantaneous closing maneuver. Time trends for flow pressures and velocity at different sections along the pipe for instantaneous closing maneuver. Fast and slow closing maneuvers
1	Transitory processes in pressurized pipelines. The function of the air pressure tanks in a pumping station of a building after the stopping of the pump

Hrs	Practice
4	Hydrostatic. Computation of static fluid action over on flat and curved surfaces.
4	Ideal fluids. Piezometric and of total loads lines for variable diameter pipes. Calculation of hydraulic forces over special pieces of pipes (e.g., sharp bends, pieces with variable diameter)
7	Hydraulic computation of a pumping station
5	Pumping station and identification of the flow regime
4	Pumping station with vaccuum portions of pipes. The piezometric and total energy lines