UNIVERSITÀ DELLA CALABRIA
DIPARTIMENTO DI **INGEGNERIA DELL'AMBIENTE**

HYDRAULIC CONSTRUCTIONS FOR SUSTAINABLE DEVELOPMENT
A.A. 2021/2022

Denominazione insegnamento	HYDRAULIC CONSTRUCTIONS FOR SUSTAINABLE DEVELOPMENT	
Codice insegnamento	27000219	
Corso di Studio (CdS)	ENVIRONMENTAL AND TERRITORIAL SAFETY ENGINEERING	
Livello CdS	SECOND	
Codice CdS	0773	
Settore Scientifico Disciplinare (SSD)	ICAR/02	
Crediti Formativi Universitari (CFU)	9	
Tipologia Attività Formativa (TAF)	Caratterizzante	
Tipo attività formativa	COMPULSORY	
Anno di corso	1	
Periodo didattico	SECOND SEMESTER	
Docente responsabile	MACCHIONE FRANCESCO	
Altri docenti coinvolti		
Organizzazione didattica*	***Ore Lezioni***	54
	Ore Esercitazioni	18
	Ore Laboratorio	---
	Ore Studio individuale	153
Lingua di insegnamento	ITALIAN	
Propedeuticità	NONE	
Prerequisiti	Hydraulics e Hydrology	
Contenuti	The course deals with the description of the purposes and functional details of the classic hydraulic engineering structures and develops for each of them design or functional verification procedures based on appropriate approaches for the correct sizing for reaching a sustainable development of the territory.	
Obiettivi formativi (in termini di risultati di apprendimento attesi)	The course should enable students to produce a conceptual design of the common hydraulic engineering structures based on approaches adequate to achieving a sustainable development of the territory. In particular, the student will acquire the knowledge and ability to understand the main hydraulic engineering works, the purposes of each of them, their importance for the use of water resources and for the territory safety. For each of the categories of the works studied, the hydraulic calculation procedures for the design or verification of correct operation will be studied, with reference to the national regulatory framework. From the application point of view, the student will be able to formulate the equations that describe the functioning of the works and that can be used for the hydraulic sizing of the same. The application part will be developed by solving practical problems, designing a work or verifying the correct hydraulic operation. The exercises will be referred, whenever possible, to territorial situations of direct knowledge of the student, in order to stimulate as much as possible, the ability of a critical and conscious judgment on the territory in which he lives. For each of the aforementioned application activities, the student will be required to prepare reports, in order to help him acquire the ability to know how to justify and argue the choices of the methods and design parameters used to solve the problem, with undoubted positive repercussions on the increase critical skills on the problem being analyzed and on the ability to communicate with solid and clear arguments the analyzes carried out and	

	the design choices made. Furthermore, it should be considered that the students' acquisition of the correct theoretical tools for the quantitative evaluation of the phenomena studied, the analysis of the regulatory framework and the personal application work described above, including the commitment required by the preparation of the reports, corroborated from professor office hours aimed at discussing the exercises in progress, the result will be the acquisition of mastery and autonomy for facing, during the course of studies and - in perspective - in the profession, the topics included in the course program.
Programma	**Aqueducts.** Water requirements, Population forecasts. General schemes. Design flow rates for pipelines and distribution network. Intakes. Pipelines: Analysis of the route and hydraulic design. Twinning of a pipeline aimed to increase the flow rate. Design of a pipe system with a single node. Design of a pipeline with punctual withdrawings. Sizing of a pumping station. Appurtenances and facilities for pipelines. Pipes. Materials for pipelines and their characteristics; selection criteria of pipes; junction types, laying and testing of conduits Reservoirs. Distribution networks. branched networks; looped networks. Analysis of looped networks by means numerical methods. <u>Exercises:</u> Pipeline sizing. Pipeline twinning. Branched network sizing. Analysis of a looped network. **Sewer systems**. Plano-altimetric outline of the drainage network. Estimate of waste sewage; discharge. Design of sewage networks. Urban drainage systems. Rainfall and runoff. Design return period. Probabilistic investigations on intense rainfalls; rainfall intensity-duration curves. Hydrologic models of rainfall-runoff transformation; hydraulic sizing of conduits. Appurtenances and facilities. Inlets. Manholes and junction structures. Drop structures. Overflow structures. Pumping stations. Pipes. <u>Exercises</u> Sizing of a sewer system. Sizing of an urban drainage system. **Reservoirs and dams.** Purposes of the dams and reservoirs. Dams located in Calabria. Reservoirs. Mass curve for estimating storage requirements or for determining the spill of water from the reservoir of a given capacity. Dams. Dam types. The examples of Nocelle and Cecita dams.Technical standards for the design and construction of the dams. Spillways, outlets and ancillary works. Weirs and barrages. Stilling basins. Cut-off piles. <u>Exercises</u>.

	Determination of the reservoir capacity to achieve an assigned annual regulation of the discharges. Sizing of a barrage and relative stilling basin. **Hydropower plants.** Small hydropower plants. Definitions and hydraulic layout. Hydraulic turbines. Method of selecting the right design discharge. Weirs. Intake types. Drop intakes. Flow over intake racks. Hydraulic sizing of bottom racks. Sediment traps. Sizing of the canal. Devices for limiting the maximum withdrawn discharge. Storage powerplant. Layouts. Hydraulic turbines. Waterhammer pressure caused by a sudden closure of a gate valve. Celerity of pressure wave due to water hammer. Study of mass oscillations in surge tanks. <u>Exercises</u> Determination of the design discharge, the size of the rack for a drop intake and the average annual energy production for a small hydropower plant. **Hydraulic works for road drainage.** General. Discussion of examples of bad realization and maintenance of culverts. General criteria for designing. Culvert alignment. Types of culverts. Culverts for wildlife crossing. Entrances and outlets. Culvert materials: concrete, corrugated steel.Debris deflectors for culverts. Characteristics of inlet and outlet control flow. Types of inlets. Culvert hydraulic performances. Gutter inlets for road drainage. Types of inlets. Hydraulics of the gutters and inlets. Experimental formulas for gutter and kerb inlets. <u>Exercises</u> Sizing of a culvert. Sizing of a gutter inlet. **Irrigation and subsurface drainage**. General. Crop water demands; irrigation methods; appurtenances and facilities. Subsurface drainage systems for groundwater table and salinity control. Methods; drainage systems.
Modalità di erogazione	TRADITIONAL
Metodologie didattiche	The lecture lessons are performed using the traditional blackboard. Images, videos and technical sketch are also used for the description of hydraulic structures and their operation. The tutorial lesson are focused on numerical applications of the theory. They are performed explaining how to apply the theory, and starting the computations in the class. For each numerical application, the students must draw up a report illustrating the adopted method and the numerical and graphical results.
Metodi e criteri di valutazione dell'apprendimento	During the exam, the student must show the one's own reports on the numerical applications; both the printed version and the CD have to be delivered. The exams are only oral and they concern both the discussion of the exercises and the arguments of the lectures.

	In particular, in the first part of the exam, the student is asked to illustrate some of the reports drawn up during the course as documentation of the individual work done for the exercises. The illustration will be discussed with the examination board, aimed at ascertaining the level of theoretical understanding and operational mastery of the methods applied to the cases being exercised, including the ability to realize the factors that are mainly relevant to the problem examined and the orders of magnitude of the phenomena being studied and the geometric dimensions of the designed plant. The examination continues with a more systematic assessment of the completeness of the preparation on the course program with reference to the reasons underlying the choice of the procedure for solving the problem and the mastery of the theoretical foundations and the formulation of the equations developed in the theoretical part of the course, on cases in which it is possible to simplify the equations and on the engineering aspects of the designed plant. The assessment will also include knowledge of the regulatory requirements to be fulfilled in facing the problems covered in the course. The measurement of learning will be expressed by the examination board with a final mark, which will be assigned taking into account the assessment factors described above.
Testi di riferimento ed eventuali letture consigliate	*Lecture notes*
Peer review	SAME SSD COLLEGUES
Orario delle lezioni	http://diam.unical.it
Calendario degli esami	http://diam.unical.it
Commissione d'esame	http://diam.unical.it

* Organizzazione didattica

STIMA DEL CARICO DI LAVORO PER LO STUDENTE				
	Lezioni [Ore]	**Esercitazioni [Ore]**	**Laboratorio [Ore]**	**Studio individuale [Ore]**
Introduction to the course; educational objectives ; Course topics; aims and value of exercises; operating methods of the course; methods for the exercises; reference texts; procedures for carrying out the examinations; lesson timetable; office hours; calendar **Aqueducts.** Water requirements, Population forecasts. General schemes. Design flow rates for pipelines and distribution network. Intakes. Pipelines: Analysis of the route and hydraulic design. Twinning of a pipeline aimed to increase the flow rate. Design of a pipe system with a single node. Design of a pipeline with punctual withdrawings. Sizing of a pumping station. Appurtenances and facilities for pipelines. Pipes. Materials for pipelines and their characteristics; selection criteria of pipes; junction types, laying and testing of conduits Reservoirs. Distribution networks. branched networks; looped networks. Analysis of looped networks by means numerical methods. <u>Exercises:</u> Pipeline sizing. Pipeline twinning. Branched network sizing. Analysis of a looped network.	21 (21)	7 (7)		59.5
Sewer systems. Plano-altimetric outline of the drainage network. Estimate of waste sewage; discharge. Design of sewage networks. Urban drainage systems. Rainfall and runoff. Design return period. Probabilistic investigations on intense rainfalls; rainfall intensity-duration curves. Hydrologic models of rainfall-runoff transformation; hydraulic sizing of conduits. Appurtenances and facilities. Inlets. Manholes and junction structures. Drop structures. Overflow structures. Pumping stations. Pipes.	7 (28)	3 (10)		20.5

Exercises Sizing of a sewer system. Sizing of an urban drainage system.				
Reservoirs and dams. Purposes of the dams and reservoirs. Dams located in Calabria. Reservoirs. Mass curve for estimating storage requirements or for determining the spill of water from the reservoir of a given capacity. Dams. Dam types. The examples of Nocelle and Cecita dams.Technical standards for the design and construction of the dams. Spillways, outlets and ancillary works. Weirs and barrages. Stilling basins. Cut-off piles. Exercises. Determination of the reservoir capacity to achieve an assigned annual regulation of the discharges. Sizing of a barrage and relative stilling basin.	6(34)	3 (13)		18
Hydropower plants. Small hydropower plants. Definitions and hydraulic layout. Hydraulic turbines. Method of selecting the right design discharge. Weirs. Intake types. Drop intakes. Flow over intake racks. Hydraulic sizing of bottom racks. Sediment traps. Sizing of the canal. Devices for limiting the maximum withdrawn discharge. Storage powerplant. Layouts. Hydraulic turbines. Waterhammer pressure caused by a sudden closure of a gate valve. Celerity of pressure wave due to water hammer. Study of mass oscillations in surge tanks. Exercises Determination of the design discharge, the size of the rack for a drop intake and the average annual energy production for a small hydropower plant.	10 (44)	2 (15)		27
Hydraulic works for road drainage. General. Discussion of examples of bad realization and maintenance of culverts. General criteria for designing. Culvert alignment. Types of culverts. Culverts for wildlife crossing. Entrances and outlets. Culvert materials: concrete, corrugated steel.Debris deflectors for culverts. Characteristics of inlet and outlet control flow. Types of inlets. Culvert hydraulic performances. Gutter inlets for road drainage. Types of inlets.	7 (51)	3 (18)		20.5

Hydraulics of the gutters and inlets. Experimental formulas for gutter and kerb inlets. Exercises Sizing of a culvert. Sizing of a gutter inlet.				
Irrigation and subsurface drainage. General. Crop water demands; irrigation methods; appurtenances and facilities. Subsurface drainage systems for groundwater table and salinity control. Methods; drainage systems.	3 (54)			7.5
	54	**18**		**153**
✓	✓ **225**			

Block Description 1 – Lectures 21 (21) hours, Exercises 7 (7) hours, Individual Study 59,5 hours
Introduction to the course; educational objectives ; Course topics; aims and value of exercises; operating methods of the course; methods for the exercises; reference texts; procedures for carrying out the examinations; lesson timetable; office hours; calendar
Aqueducts.
Water requirements, Population forecasts. General schemes. Design flow rates for pipelines and distribution network. Intakes.
Pipelines: Analysis of the route and hydraulic design.
Twinning of a pipeline aimed to increase the flow rate.
Design of a pipe system with a single node.
Design of a pipeline with punctual withdrawings. Sizing of a pumping station. Appurtenances and facilities for pipelines.
Pipes. Materials for pipelines and their characteristics; selection criteria of pipes; junction types, laying and testing of conduits
Reservoirs.
Distribution networks. branched networks; looped networks. Analysis of looped networks by means numerical methods.
Exercises:
Pipeline sizing.
Pipeline twinning.
Branched network sizing.
Analysis of a looped network.

Block Description 2 - Lectures 7 (28) hours, Exercises 3 (10) hours, Individual Study 20,5 hours
Sewer systems.
Plano-altimetric outline of the drainage network. Estimate of waste sewage; discharge. Design of sewage networks.
Urban drainage systems. Rainfall and runoff. Design return period. Probabilistic investigations on intense rainfalls; rainfall intensity-duration curves. Hydrologic models of rainfall-runoff transformation; hydraulic sizing of conduits. Appurtenances and facilities. Inlets. Manholes and junction structures. Drop structures. Overflow structures. Pumping stations. Pipes.
Exercises
Sizing of a sewer system.
Sizing of an urban drainage system.

Block Description 3 - Lectures 6 (34) hours, Exercises 3 (13) hours, Individual Study 18 hours
Reservoirs and dams.
Purposes of the dams and reservoirs. Dams located in Calabria.
Reservoirs. Mass curve for estimating storage requirements or for determining the spill of water from the reservoir of a given capacity.
Dams. Dam types. The examples of Nocelle and Cecita dams.Technical standards for the design and construction of the dams.
Spillways, outlets and ancillary works.
Weirs and barrages. Stilling basins. Cut-off piles.
Exercises.
Determination of the reservoir capacity to achieve an assigned annual regulation of the discharges.

Sizing of a barrage and relative stilling basin.

Block Description 4 - Lectures 10 (44) hours, Exercises 2 (15) hours, Individual Study 27 hours
Hydropower plants.
Small hydropower plants. Definitions and hydraulic layout. Hydraulic turbines. Method of selecting the right design discharge.
Weirs. Intake types. Drop intakes. Flow over intake racks. Hydraulic sizing of bottom racks.
Sediment traps. Sizing of the canal. Devices for limiting the maximum withdrawn discharge.
Storage powerplant. Layouts. Hydraulic turbines. Waterhammer pressure caused by a sudden closure of a gate valve. Celerity of pressure wave due to water hammer. Study of mass oscillations in surge tanks.
Exercises
Determination of the design discharge, the size of the rack for a drop intake and the average annual energy production for a small hydropower plant.

Block Description 5 - Lectures 7 (51) hours, Exercises 3 (18) hours, Individual Study 20,5 hours
Hydraulic works for road drainage.
General. Discussion of examples of bad realization and maintenance of culverts. General criteria for designing.
Culvert alignment. Types of culverts. Culverts for wildlife crossing. Entrances and outlets. Culvert materials: concrete, corrugated steel.Debris deflectors for culverts. Characteristics of inlet and outlet control flow. Types of inlets. Culvert hydraulic performances.
Gutter inlets for road drainage. Types of inlets. Hydraulics of the gutters and inlets. Experimental formulas for gutter and kerb inlets.
Exercises
Sizing of a culvert.
Sizing of a gutter inlet.

Block Description 6 - Lectures 3 (54) ore, Individual Study 7,5 ore
Irrigation and subsurface drainage.
General. Crop water demands; irrigation methods; appurtenances and facilities.
Subsurface drainage systems for groundwater table and salinity control. Methods; drainage systems.