UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

WATERSHED PROTECTION AND MANAGEMENT

Enrollment year	2019/2020
Academic year	2021/2022
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 per l'ambiente e il territorio
Year of study	3°
Period	2nd semester (07/03/2022 - 17/06/2022)
ECTS	6
Lesson hours	53 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	BOLLINI FULVIO (titolare) - 6 ECTS
Prerequisites	Mathematical Analysis, Physics, Hydraulics, Hydrology
Learning outcomes	Watershed Hydraulic Management gives the basic elements for land protection, conservation and reclamation, and for a correct, environmental friendly land utilization.
Course contents	Lectures (30 hours) Course content and definitions (2 hours) Waterworks and interventions constituents watershed Hydraulic management and their finality. Definition, delimitation and characteristics of a river basin (recalls). Features of a water course. Cartographic and photographic representation of a river basin and of a water course

Water in the soil (4 hours)
Soil physical and mechanical characteristics . Occurrence, nature and movement of water in soil: moisture, capillarity, infiltration, percolation, ground water flow.

Irrigation (6 hours)
Relationship between water and soil. Free energy, humidity and humidity constant, aqueous fractions of the soil, water useful to plants, soil specific curves, irrigation intervals soil. Relations between water and plants: plant transpiration, evaporation from the soil, evapotranspiration. Irrigation parameters: specific irrigation intervals flow, shift distribution, schedule. Terminology, types and methods of irrigation, artefacts and ancillary works (intake works, works of hydraulic regulation, delivery and measure).

Soil drainage and Land reclamation (6 hours)
The effects of water excess on surface and in soil profile. Ground water drainage: horizontal pipes system, deep wells system: criteria and methods for planning and design. Subsurface and surface drainage systems. Hydraulics of wells . The problem and the proposed solutions during the centuries. Estimation of design discharge for the channel network: statistical analysis of measured discharges, rainfall-discharge relationships and models. The drainage network: hydraulic design of stable channel section, and associated structures. Pumps ad pumping stations. Peak discharge reduction through storage.

Water safety and flood control (4 hours)
The flood risk. The problems of hydraulic defense. Interventions for flood control: structural and non-structural. Structural interventions: interventions to increase the conveying capacity (through excavations or embankments), interventions for the reduction of the flow through distribution of flood discharge (overflows or diversion canals) or through retarding and balancing basins. Non-structural interventions: planning at the basin scale and river basin district, PAI (Plan for the hydrogeological attitude), country planning, monitoring systems and data transmission for the announcement of floods, of safety interventions.

Soil erosion (2 hours)
Physical processes, space and time scaling of the phenomenon. Modeling the erosion: the universal soil loss equation (U.S.L.E.), physically based models. Prevention and remediation: control methods and strategies.

Mountain basin training and restoration (6 hours)
Physical processes in natural channels (sediment transport, erosion, deposition) and on the slopes (surface erosion and mass movement). Criteria for the control of grading/degrading in the stream network and for the control of bank erosion: design of sills for bed fixation, revetments of bed and banks, sills and storage area for sediment control in alluvional fans. Monitoring and restoration of slopes: surface runoff control, deep and subsurface drainage for control and prevention of landslips and landslides, recovering of the green and wood cover.

	Practical class (18 hours) • Pract. n. 1. Design of an irrigation canal and of a pipeline: computation of the critical design discharge, sizing of a stable channel section. Maximum flow in open channel section symmetrical trapezoidal, non symmetrical and with docks. Maximum flow in a fully or partially filled pipe. Flow scale. (2 ore) • Pract.. n. 2. Mode of measurement and calculation of flow rate dispensed by gravity. Volume of irrigation determination in an irrigation area. (2 ore) • Pract. n. 3. Design of horizontal groundwater drainage system: layout of the draining module, pipes spacing, diameter of drains and collector. (2 ore) • Pract. n. 4. Design of vertical groundwater drainage system: number and position of wells, pumps discharge and power.. (4 ore) • Pract. n. 5. Design of the main channel of a reclamation network: computation of the critical design discharge, sizing of a stable channel section. (4 ore) • Pract. n. 6. Design of a peak discharge reduction reservoir. (2 ore) • Pract. n. 7. Design of a retarding reservoir by kinematic method, design of a spillway side. (2 ore)
Teaching methods	Lectures (hours/year in lecture theatre): 30 Practical class (hours/year in lecture theatre): 18 Practicals / Workshops (hours/year in lecture theatre): 0
Reccomended or required readings	The computer programs, the slides used for the lessons and the notes relevant to lectures and practical class can be found in Kiro, time by time, and downloaded. Can be useful the lecture notes of the course held by Prof. ing. Mario Fugazza until AA 2013-14 C. Costantinidis. Bonifica ed Irrigazione. Edagricole, 1970. AA.VV.. Drainage principles and applications. ILRI, Wageningen, The Netherland, 1983. G. Ongaro. Il calcolo delle reti idrauliche di bonifica. Edagricole, 1958. G. Supino. Le reti idrauliche. Patron, 1965. G. Benini. Sistemazioni Idraulico forestali. UTET, 1990. V. Ferro. La Sistemazione dei bacini Idrografici. Mc Graw-Hill, 2002.
Assessment methods	The exam is composed of a written test, divided into a theoretical part (from 3 to 10 open-ended questions) and a practical part (from 1 to 3 exercises). To each of the two parties is attributed a mark on a scale of 30. The final evaluation of the written test will be the arithmetic mean between the marks obtained in the two parts, but to pass the written test, students must obtain at least 12/30 in each of the two parts, otherwise they will pass an oral test. The final mark is that decided by the commission, based on the results of written and oral test. Students who

	have passed the written test can seek to obtain an higher mark with an oral test. Otherwise the final mark will be the arithmetic mean between the marks of written and oral test.
Further information	The exam is composed of a written test, divided into a theoretical part (from 3 to 10 open-ended questions) and a practical part (from 1 to 3 exercises). To each of the two parties is attributed a mark on a scale of 30. The final evaluation of the written test will be the arithmetic mean between the marks obtained in the two parts, but to pass the written test, students must obtain at least 12/30 in each of the two parts, otherwise they will pass an oral test. The final mark is that decided by the commission, based on the results of written and oral test. Students who have passed the written test can seek to obtain an higher mark with an oral test. Otherwise the final mark will be the arithmetic mean between the marks of written and oral test.
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile