

Code: 1428 Fluid Mecanics**Degree:** 2nd cycle – Environmental Engineering**Stream:** all**Curricular Year:** 1st**Semester Course:** 1st**Credits:** 6 ECTS**Compulsory****Language:** Portuguese/English**Responsible:** Maria do Rosário da Conceição Cameira**Other lecturer(s):** -**Web Site:** <http://www.isa.utl.pt/home/node/3776>**1. Contact hours:****Lecture/Practicals 70 Others 14 Total 84****2. Objectives:**

To prepare the students:

- for the design of the retention and transport structures (reservoirs, sedimentation tanks, pipe systems and channels) for clear water and residual water from agriculture activities;
- to select the most efficient pumping systems for clear water and residual water from agriculture activities;
- for the calculation of the fluid transport in porous media (soil vadose zone) in order to estimate travel times to the groundwater

3. Programme:

1. Fluid mechanics and fluid properties: temperature, specific weight, internal energy, kinetic and potential energy, compressibility, viscosity, surface tension; velocity and pressure fields. Most common analysis techniques used in fluid mechanics.
2. Static fluids: pressure; pressure distribution inside a static fluid: pressure measurement by manometers, forces on vertical submerged surfaces in static fluids. Design of reservoirs; forces on submerged objects: buoyancy.
3. Fluid kinematics: flow fields; spatial and temporal flow classification; laminar and turbulent flow.
4. Fluid dynamics: Concepts: flux tube, flow section, flow rate, average velocity. Fundamental theorems in fluid mechanics for ideal fluids in steady flow: continuity equation; momentum equation - Euler theorem; Energy equation - Bernoulli theorem;
5. Pressure flow in pipes: pressure head, velocity head, potential head and total head in a pipeline; pressure loss due to friction in laminar and in turbulent flows; local head losses. Pipe systems in series and in parallel; branched pipes. total dynamic head; water horse power; pump efficiency; application to newtonian and non-newtonian fluids.
6. Turbo machines: concepts; control variables; pump performance curve: installation performance curve; optimal functioning point; pumps in series and in parallel; net positive suction head, installation without cavitation.
7. Open channel flow: Pressure losses in steady flow; channel cross section design; critical, slow and rapid flow.
8. Solid transport – Solid liquid separation. Motion of particles in fluids; gravity settling at low concentrations; hindered settling at low concentrations; centrifugal sedimentation; sedimentation tank design for the primary treatment of residual waters.
9. Flow in porous media. Porous media properties. Soil water: mass and energy; Soil hydraulic properties: retention curve and hydraulic conductivity curve; hydraulic flux; water movement in saturated soil: Darcy's law, saturated hydraulic conductivity; Steady flow in non saturated soil: Darcy-Buckingham equation; transient flow in non saturated soil: Richards equation.

4. Bibliography:**Main Bibliography**

- Quintela, António. 2000. Hidráulica. Fundação Calouste Gulbenkian, Lisboa
- Svarovsky, Ladislav. 2000. Solid-liquid separation. Butterworth-Heinemann, Oxford
- Kutílek, Miroslav e Nielsen, Donald. 1994. Soil Hydrology. GeoEcology textboo
- Course specific notes

Other Bibliography

White, Frank. 1999. Mecânica de Fluidos. McGraw Hill
Hillel, Daniel. 1980. Soil physics. Académic Press

5. Assessment:

Frequency: (not for the working students): 75 % of the Lecture/Practical classes

Evaluation:

a) 2 tests during the semester. Each test presents a theoretical part (6/20) and a problem resolution part (14/20). Minimum grade is 8/20 in each test. Final grade is the arithmetical average of both testes, and must be = 10/20; or

b) final exam: for the students that didn't get the minimum required in a). The final exam presents a theoretical part (6/29) and a problem resolution part (14/20). Minimum grade is 8/20 in each test. Final grade is the arithmetical average of both testes, and must be = 10/20

6. Estimated Workload:

168	Hours
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7. Last Update:

20/7/2010
