Code: 1775 **Water, Wastewater and Waste Treatment**
Degree: 1st cycle – Food Science and Engineering, Environmental Engineering, Animal Production Engineering
Curricular Year: 3rd **Semester Course: 1st**
Credits: 6 ECTS **Compulsory**
Language: Portuguese/English
Prerequisites: Organic Chemistry and Biochemistry
Responsible: Elizabeth da Costa Neves Fernandes d'Almeida Duarte
Other lecturer(s): Henrique Manuel Filipe Ribeiro, Ana Cristina Ferreira da Cunha Queda and Maria Odete Pereira Torres
Web Site: http://www.isa.utl.pt/home/node/4027

1. Contact hours:
Lectures 28 **Lecture/Practicals** 14 **Laboratory** 28 **Others** 14 **Total** 84

2. Objectives:

The main objectives of this course are to review the various sources of Water/Wastewater/sludges pollution in order to recognize the opportunities for eliminating, minimizing, reusing or treating these sources so that their negative effect on the environment will be minimized.
Introduction of the fundamental concepts of material balances and reactions occurring in reactors applied to water supply, wastewater treatment and solid and hazardous waste management
The students should be able to deal with both ground water and surface water supply including the operations of atypical water treatment plant, water softening and disinfection as well as wastewater/sludge treatment and disposal.

3. Programme:

1. Fundamentals
1.1. Engineering Calculations.
1.2. Material Balances and Separations
1.3. Reactions.
1.4. Reactors.
1.5. Energy Flows and Balances.
1.6. Ecosystems.
2. Water Quality. Water Supply and Treatment
2.1 The Hydrologic Cycle and Water Availability
2.1.1. Groundwater Supplies.
2.1.2. Surface Water Supplies.
2.2. Water Treatment.
2.2.1 Softening.
2.2.2. Coagulation and Flocculation.2.2.3. Settling.
2.2.4. Filtration.
2.2.5. Disinfection.
3. Wastewater Treatment..
3.1. Wastewater Transport.
3.2. Preliminary and Primary Treatment
3.2.1. Preliminary Treatment.
3.2.2. Primary Treatment.
3.3 Secondary Treatment.
3.3.1. Fixed Film Reactors.
3.3.2. Suspended Growth Reactors.
3.3.3. Design of Activated Sludge Systems Using Biological Process Dynamics.
3.3.4. Gas Transfer.
3.3.5. Solids Separations.
3.3.6. Effluent.
3.4 Tertiary Treatment.
3.4.1 Nutrient Removal.
3.4.2. Further Solids and Organic Removal.
3.4.3. Wetlands
4. Sludge Treatment and Disposal.
4.1. Sludge Stabilization.

4.2 Sludge Dewatering.
4.3. Ultimate Disposal.
5. Selection of Treatment Strategies

Practical classes, laboratorial classes, case studies and visits

4. Bibliography:

Main Bibliography

- Duarte, E. (2007). *Manual de Tratamento águas, efluentes e resíduos*. Serviço de Reprografia do ISA, 2008.
- Hammer, M.J., Hammer Jr., Mark J. (2001). *Water and Wastewater Technology*. 4th Ed. Prentice-Hall Inc. New Jersey.
- Kiely, G. (2003). *Ingeniería Ambiental – Fundamentos, Entornos, Tecnologias y Sistemas de Gestion*. McGraw-Hill, International , UK. Impresa S.A.
- Metcalf & Eddy, Inc. (1991). *Wastewater Engineering: Treatment, Disposal and Reuse*. 3rd Ed., McGraw-Hill, Inc., Singapore.
- Sawyer, C.N., McCarty, P.L., Parkin, G.F. (1994). *Chemistry for Environmental Engineering*. 4th Ed. McGraw-Hill, Inc.

Other Bibliography

- Sincero, A.P., Sincero, G.A. (2003). *Physical-Chemical Treatment of Water and Wastewater*. IWA Publishing. CRC Press.
- Lens, P., Pol, L.H., Wilderer, P., Asano, T. (2002). *Water Recycling and Resource Recovery in Industry*. . Integrated Environmental Technology Series. IWA Publishing, UK.
- Lens, P., Hamelers, B., Hoitink, H., Bidlingmaier, W. (2004). *Resource Recovery and Reuse in Organic Solid Waste Management.* Integrated Environmental Technology Series. IWA Publishing, UK.
- Mata-Alvarez, J. (2003). *Biomethanization of the Organic Fraction of Municipal Solid Wastes*. Integrated Environmental Technology Series. IWA Publishing, UK.

5. Assessment:

The assessment is organized in two parts.
Part one is concerned with laboratory course where the students developed team work applied in the area of water, wastewater and residues analysis.
Written report of laboratory course; practical final examination.
Part two is a continuous assessment through midterm tests, emphasizing the understanding of the principals of the topics lectures, solving questions applied to environmental problems.
Written final examination.

6. Estimated Workload:	168	Hours
7. Last Update:	24/1/2011	