UNIVERSITY of NICOSIA

| Course Code | Course Title | ECTS Credits |
|---|---|---|
| MENG-480 | Water Engineering and Desalination | 6 |
| **Department** | **Semester** | **Prerequisites** |
| Engineering | Fall, Spring | CHEM-106 |
| **Type of Course** | **Field** | **Language of Instruction** |
| Elective | Engineering | English |
| **Level of Course** | **Year of Study** | **Lecturer(s)** |
| 1st Cycle | 4th | Dr Constantinos Hadjistassou |
| **Mode of Delivery** | **Work Placement** | **Co-requisites** |
| Face-to-face | N/A | None |

**Objectives of the Course:**

- Appreciate the need for water purification and desalination;
- Define water quality, access to water, water availability and demand;
- Cover the characteristics of water reactors and chemical reaction in water quality engineering;
- Analyse the processes for the removal of dissolved constituents and particles from water;
- Overview of the techniques for membrane and wastewater treatment;
- Introduce attendees to prevailing and emerging desalination technologies;
- Present the spectrum of traditional thermal processes;
- Explain the characteristics of membrane processes;
- Outline the available unconventional desalination processes;
- Prospects of renewable energy sources as applied to desalination;
- Examine the economic aspects of desalination;
- Present the environmental, energy and climate change aspects of desalination and water engineering;

**Learning Outcomes:**

Upon completion of the course students are expected to:

- Understand the motivation of water engineering and desalination;
- Familiarise themselves with the attributes of water quality, water chemistry, and water demand/supply dynamics;
- Describe the fundamentals of water reactors including mass balance, reaction kinetics and performance;
- Help design gas reactors factoring in gas transfer and adsorption in water;
- Acquaint themselves with particle treatment processes, gravity separation, etc;
- Become familiar with thermal desalination processes;
- Know the array of membrane desalination processes;
- Be aware of the emerging desalination technologies;

- Appreciate the prospects of solar desalination and future direction;
- Recognise the environmental challenges of water engineering and desalination, energy footprint, climate change aspects and virtual water footprint.

**Course Contents:**

Course syllabus comprises:

- Need for water engineering and desalination, terminology, overview of technologies;
- Attributes of drinking water quality, health and aesthetic aspects of drinking water;
- Water composition, chemical principles, watershed protection;
- Functions of water reactions, mass balances and hydraulic characteristics;
- Reaction kinetics of reversible and irreversible reactions, performance attributes of reactions;
- Basics of gas transfer systems, reactor designs and performance, fundamentals of adsorption processes, precipitation and dissolution techniques;
- Thermodynamic characteristics, mass-energy balance and performance of thermal desalination processes, membrane distillation;
- Reverse osmosis, water transport, salt passage and rejection, spiral wound elements, biofouling, etc;
- Forward osmosis, the Draw solution & the membrane, electrodialysis desalination;
- Non-conventional desalination technologies: freezing-melting desalination, ion exchange, electrosorption, etc
- Direct and indirect solar desalination, process analysis;
- Environmental issues of water engineering and desalination, calculation of energy and carbon footprint, economic analysis of desalination, concept of virtual water.

**Learning Activities and Teaching Methods:**

Lectures, in-class exercises, examples

**Assessment Methods:**

Problem sheets, mid-term, final exam

**Required Textbooks/Reading:**

| Authors | Title | Publisher | Year | ISBN |
|---|---|---|---|---|
| El-Dessouky H.T. & Ettouney H.M. | Fundamentals of Salt Water Desalination | Elsevier | 2002 | 0-444-50810-4 |

**Recommended Textbooks/Reading:**

| Authors | Title | Publisher | Year | ISBN |
|---|---|---|---|---|
| Edzwald J.K. | Water Quality & Treatment: a Handbook on Drinking Water | McGraw-Hill | 2011 | 978-0-07-163010-8 |
| Benjamin M.M. & Lawler D. F. | Water Quality Engineering: Physical/ Chemical Treatment | Wiley | 2013 | 978-1-118-16965-0 |

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| | Processes | | | |