

CL810 DESALINATION POWERED BY RENEWABLE ENERGY

PRE-REQUISITE

Knowledge in renewable energy based applications.

COURSE LEARNING OBJECTIVES

1. To learn the principle and technical concepts desalination.
2. To understand the less energy intensive processes for desalination applications.
3. To apply the knowledge in designing desalination powered by renewable energy

Introduction : Basics and principles of salt water chemistry. Definition and fundamentals of desalination. Historical overview Conventional desalination processes and technologies. Current technologies, their evolution and perspectives. Renewable energies in relation to desalination. State of the art of renewable energy generation technologies and their application to desalination processes. Technologies for desalination powered by renewable energy. Description of the basics of the technology and the development of the engineering of several desalination processes powered by solar energy.

Solar thermal energy and desalination: Solar stills. Simple distillation systems based on the passive evaporation of saline water in greenhouse-type devices. High capacity solar thermal distillation. Advanced systems of thermal distillation using active solar heating, as multi-effect distillation (MED) and multi-stage flash distillation (MSF). Solar thermal membrane distillation. Thermally-driven systems based on hydrophobic micro-porous membranes to separate vapour from a salt water stream through the establishment of a vapour-liquid interface between both sides of the membrane. Solar thermal humidification/dehumidification. Technologies that replicate the natural cycle of water, with evaporation of saline water and condensation at atmospheric pressure. Solar ponds. Thermal desalination processes coupled with salinity-gradient solar ponds as a source of thermal energy. Solar photovoltaic and desalination. Combination of electricity produced by solar photovoltaic energy and desalination using techniques of reverse osmosis and electrodialysis reversal.

Wind energy and desalination: Combination of electricity produced by wind energy and desalination using techniques of reverse osmosis and electrodialysis reversal.

Other renewable energy sources and desalination: Other processes which associate wave, tidal or geothermal energy generation with desalination.

Design and operation: Operation and management of industrial plants. Control and remote monitoring systems. Handling of detrimental effects as scaling, corrosion and fouling. Necessary pre-treatments and post-treatments to guarantee successful plant operation. Optimization of energy consumption and water cost.

Senate

RAS

Environmental implications of desalination technologies and their association with renewable energies. Economic and sustainability issues of desalination powered by renewable energy. Basic economics of the described technologies, costs of operation and maintenance, desalinated water tariff, etc. Sustainability also entails other aspects of society, as the policies of desalination and the involvement of the local community.

COURSE OUTCOME

Upon completing the course, the student will be able to

CO1	Know the basics and working principles of desalination technologies.
CO2	Understand renewable energy generation technologies and their application to desalination processes
CO3	Design an industrial plants with optimization of energy consumption and water cost
CO4	Understand the Environmental implications of desalination technologies

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	√	√			√						
CO2		√		√							
CO3			√			√			√		
CO4			√				√			√	√

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1		Introduction to History and Desalination as a source of water and Challenges	Lecture/ PPT Presentation/ Video Demonstrations/ Team Presentations
2		Basic Principles of Salt Water Chemistry	
3		Definition and Fundamentals of Desalination	
4		Various Types Power Sources and Challenges	
5		Electro-Dialysis Principles and Applications	
6		Environmental and Sustainability issues of desalination	
7		Economic Evaluation of Desalination Processes	

COURSE ASSESSMENT METHODS				
S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Cycle Test	October, 28 th 2016	60 minutes	20
2	Surprise Test		10 minutes	10
3	Team Projects/Tasks		Four Weeks	20
4	End Sem Exam	As per institute's academic calender	180 minutes	50
ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc				
<ol style="list-style-type: none"> 1. Noam Lior, <i>Advances in Water Desalination</i>, Volume 1, John Wiley & Sons, 2013 2. Jochen Bundschuh and Jan Hoinkis, <i>Renewable Energy Applications for Freshwater Production</i>, CRC Press, Taylor & Francis Group, 2012. 3. Andrea Cipollina, Giorgio Micale and Lucio Rizzuti, <i>Seawater Desalination: Conventional and Renewable Energy Processes</i>, Springer-Verlag Berlin Heidelberg 2009. 4. Michael Papapetrou, Charlotte Biercamp and Marcel Wiegand, <i>Roadmap for the development of desalination powered by renewable energy</i>, Fraunhofer-Verlag 2010. 5. Irena A. Urbonienė, <i>Desalination : methods, costs and technology</i>, Nova Science Publishers, 2010 				