

Course Code		Course Title	Desalination Systems			
Dept. /Faculty proposing the course	Mechanical Engineering / Dr.B.Raja	Structure (LTPC)	L	T	P	C
			3	1	0	4
To be offered for	UG/PG	Type	Core ☐		Elective ☒	
		Status	New ☒		Modification ☐	
Pre-requisite	Heat Transfer	Submitted for approval			Senate :	
Learning Objectives	- To introduce the fundamental thermodynamic, transport, and engineering principles involved in desalination and water purification technologies. - To develop the ability to analyze and design desalination systems such as thermal, membrane, freeze, and vacuum desalination processes for practical applications.					
Learning Outcomes	- Explanation and comparison of various desalination technologies based on their principles, energy requirements, and operational characteristics. - Perform basic design calculations and evaluate the performance and economics of desalination systems for real-world applications.					
Contents of the course (With approximate break-up of hours for L/T/P)	Global water scarcity and desalination demand, Seawater composition and salinity measures, Water quality standards (WHO, BIS), Thermodynamics of separation processes, Minimum work of desalination, Osmotic pressure and van't Hoff equation, Boiling point elevation, Freezing point depression, Exergy analysis of desalination systems (8L + 2T) Multi-Stage Flash (MSF) desalination, Flash chamber and brine heater design, Gain Output Ratio (GOR), Multi-Effect Distillation (MED), Heat transfer analysis in MED, Vapor Compression desalination (MVC / TVC), Vacuum desalination principles, Low-temperature evaporation under vacuum, Vacuum pump selection and performance (9L + 3T) Fundamentals of freeze desalination, Ice crystallization and salt rejection mechanism, Freezing point depression of seawater, Direct freeze desalination, Indirect freeze desalination, Vacuum freeze desalination, Ice–brine separation and washing columns, Refrigeration systems for freeze desalination, Energy comparison with thermal systems (7L + 3T) Reverse Osmosis (RO) fundamentals, Membrane transport mechanisms, Concentration polarization, Spiral wound and hollow fiber modules, Energy recovery devices, Electrodialysis (ED) and Electrodialysis Reversal (EDR), Limiting current density, Membrane distillation, Forward osmosis and nanofiltration (9L + 3T) Seawater intake systems, Pretreatment and filtration, Scaling, fouling and corrosion control, Materials used in desalination plants, Hybrid desalination systems (RO–MED, solar desalination), Environmental impacts and brine disposal, Energy consumption comparison of desalination technologies, Cost estimation (CAPEX and OPEX), Levelized Cost of Water (LCOW), Case studies of large desalination plants (9L + 3T)					
Text Books	- Louis Theodore and R. Ryan Dupont, Introduction to Desalination: Principles, Processes, and Calculations, Wiley, 2022. ISBN-13: 978-1119691679 - Iqbal M. Mujtaba and Md Tanvir Sowgath, Desalination Technologies: Design and Operation, Elsevier, 2022. ISBN-13: 978-0128137901.					

Reference Books	1. Inamuddin and Anish Khan (Editors), Sustainable Materials and Systems for Water Desalination, Springer, 2021., ISBN-13: 978-3030728731. 2. G. K. Prashanth, Hemantkumar N. Akolkar, A. K. Haghi, Srilatha Rao, Seawater Desalination: Technologies and Environmental Impact, Springer, 2026, ISBN-13: 978-3031982316.
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