

# COURSE TITLE: ELECTRICAL & MECHANICAL SYSTEMS

## COURSE DESCRIPTION

Electrical and mechanical systems form the operational heartbeat of modern water and sanitation utilities, driving the heavy-duty extraction, treatment, and distribution of water resources. Sustainable utility management relies heavily on minimizing energy wastage, optimizing pumping lifecycles, and ensuring the seamless integration of hydromechanical components. This unified section equips utility professionals with specialized expertise in energy efficiency, high-capacity tubewell design, and comprehensive wastewater treatment facility management. It bridges the gap between hydrological assessments and electro-mechanical engineering by covering rigorous energy auditing, pump and motor optimization, and complex electrical control panel management. Furthermore, it integrates advanced environmental engineering by training officials on stringent water quality testing (NEQS), open-channel flow measurement, and the daily operational oversight of wastewater disposal stations. Through hands-on diagnostics and engineering calculations, this program empowers utilities to drastically reduce their carbon footprint, lower operational electricity costs, and ensure regulatory-compliant, energy-optimized water operations.

### About This Course

Below are the trainings aligned with this course category, along with their respective modules. These have been designed to systematically address the outlined objectives and enhance participant capacity.

<i>Training 1</i>	<i>Water &amp; Wastewater Management: Understanding Treatment Technologies, Quality Testing &amp; Standards, Flow Measurement in Open Channels and complete overview of a Wastewater Disposal Station.</i>
<b>Module 1: Flow Measurement &amp; Plant Hydraulics</b> (Open channel flow measurement, and discharge analysis using ultrasonic flow meters, weirs, and flumes for plant optimization). <b>Module 2: Disposal Station Mechanical Operations</b> (Pumping station operations, mechanical screening, grit removal, hardware preventive maintenance, and emergency response planning for disposal stations).	
<b>Objectives</b> <ul style="list-style-type: none"><li>• Evaluate water and wastewater treatment technologies, encompassing primary, secondary, and tertiary processes for effective environmental management.</li><li>• Execute stringent water quality testing protocols (BOD, COD, TSS) and ensure facility compliance with NEQS environmental standards.</li><li>• Manage the complete daily operations of wastewater disposal stations, including heavy pumping protocols, mechanical screening, grit removal, and preventive maintenance.</li></ul>	
<i>Training 2</i>	<i>Energy Savings: Mastering Energy Audits, Efficiency Planning, and Electric Panel Management for Optimized Performance</i>
<b>Module 1: Pump Efficiency &amp; VFD Integration</b> (Motor load profiling, pumping efficiency evaluation, high-efficiency motor transition, and hands-on VFD integration).	

<b>Module 2: Electric Panel Troubleshooting &amp; Power Factor</b> (Three-phase panel architecture, Star-Delta starters, fault diagnostics, overload relays, and reactive power correction via capacitor bank sizing).	
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>• Evaluate pump and motor efficiency to facilitate high-efficiency motor transitions and Variable Frequency Drive (VFD) integration.</li> <li>• Troubleshoot three-phase electric panel architectures, Star-Delta starters, and overload relays to prevent critical electrical faults.</li> <li>• Optimize power factor and correct reactive power using precise capacitor bank sizing.</li> </ul>	
<i>Training 3</i>	<i>Tubewell Design and Installation: Hydrological, Electrical &amp; Mechanical Considerations.</i>
<b>Module 1: Submersible Pump Selection &amp; Hydraulics</b> (Pump curve matching, TDH calculations, system resistance, vibration control, and hydraulic installation).	
<b>Module 2: Electrical Sizing &amp; Energy Optimization</b> (Motor sizing, Star-Delta starter configuration, VFD integration, power factor correction, fault protection, and energy auditing).	
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>• Assess aquifer hydrology and execute resistivity surveys to determine optimal well siting and safe groundwater extraction yields.</li> <li>• Design mechanical well structures, incorporating rotary and percussion drilling methods, exact screen selection, and gravel packing.</li> <li>• Select and install submersible pumps perfectly matched to precise Total Dynamic Head (TDH) calculations, and configure customized electrical control panels to maximize long-term energy optimization.</li> <li>• Configure customized electrical designs for high-capacity tubewells to maximize long-term energy optimization and equipment lifespan.</li> </ul>	

## Provisions

The following details outline the delivery format, practical tools, and safety equipment provided to support participants throughout this hands-on training module.

Operational Aspect	Details
<b>Mode of Delivery</b>	Face-to-Face, Engineering Calculations, Laboratory Demonstrations, and Field Site Visits.
<b>Language</b>	English & Urdu.
<b>Teaching Methods</b>	Presentations in addition with activities, group discussions, hands-on lab water testing, open channel flow calculations, electric panel testing, pump efficiency drills, and guided field visits to disposal stations and tubewells.
<b>Tools &amp; Equipment</b>	Desktop Computers/Laptops (Core i7/i5), Projector & Screen, Ultrasonic Flow Meters, Power Analyzers (Kyoritsu KEW-6315), Power Meters with PF Capability, Insulation Testers, Digital Earth Testers, Digital Tachometers, Vibration Meters, Clamp Meters, Water Level Indicators, Temperature Meters, Sludge Measuring Rods, and Panel Model (Star Delta) for demonstration. <b>Personal Protective Equipment (PPE) Includes:</b> Safety Helmets, Safety Shoes, Safety Goggles, Safety Gloves, and Lab Coats (required for hardware handling, panel demonstrations, laboratory testing, and site visits).

<b>Residence Facilities</b>	On-campus hostel facilities are available for out-of-station participants attending the training.
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