

## **Power Electronics** **for Advanced AC & DC Grid Applications**

### **ORGANIZED BY**

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As global energy systems undergo a fundamental shift toward carbon neutrality, the architecture of the power grid is evolving into a complex hybrid of AC & DC systems. This special session focuses on the critical role of Power Electronics (PE) as the primary enabler of this transition. Traditional grids are being replaced by "converter-dominated" systems where power electronic interfaces manage everything from renewable energy harvesting to energy storage systems and high-speed vehicle charging. This session aims to bridge the gap between circuit-level innovations (topologies and devices) and system-level applications (stability and grid services).

### LIST OF TOPICS

#### **ADVANCED CONVERTER TOPOLOGIES**

- Next-Generation Inverters: Development of Multi-level converters (MMC) and the comparison of grid-forming (GFM) versus grid-following (GFL) control strategies.
- DC-DC Conversion: High-gain isolated converters tailored for PV and fuel cell integration.
- Energy Storage & Mobility: Bidirectional converters for Energy Storage Systems (ESS) and EV applications.
- Solid-State Transformers (SST): Hardware design and control strategies for seamless AC/DC network interconnection.

#### **DC GRID EVOLUTION**

- LVDC, MVDC & HVDC grids: Protection strategies, fault detection, and circuit breaker technologies.
- DC Microgrids: Voltage regulation, load sharing, and stability analysis in islanded vs. grid-connected modes.
- Data Center Power: Ultra-efficient DC distribution for high-density computing loads.

#### **SMART GRID SUPPORT**

- FACTS & HVDC: Enhancing transmission capacity and stability using flexible AC transmission systems.
- Active Power Filtering: Real-time harmonic compensation and reactive power support at the distribution level.
- Virtual Synchronous Machines: Providing synthetic inertia to low-inertia AC grids.

#### **EMERGING TECHNOLOGIES & DIGITALIZATION**

- Power Semiconductors: Application of IGBT, SiC and GaN in grid-scale converters.
- AI and Digital Twins: Machine learning for predictive maintenance of power modules and real-time optimization of hybrid grids.
- Cyber-Physical Security: Resilient control of power electronic interfaces against cyber threats.

