Tutorial Proposal Form

1. Tutorial Title:

Supercapacitor Assisted Power Converters and Protection Systems for DC Homes and DC Appliances Based on Renewable Energy

2. **Tutorial overview or scope (abstract) in English**

Supercapacitors are typically one million larger capacitances for the same canister volume compared to electrolytic and film capacitors. Today commercial devices come in capacitance values ranging from fractional farads to 100,000 farads (per single cell) with life cycles in the range of 30 k to 1 million. They have a several orders higher power density than li-ion rechargeable batteries with a much wider operational temperature range. However, they haven't reached the energy density of rechargeable battery chemistries.

Based on the low equivalent series resistance (ESR) property of supercapacitors, a unique new family of power converters and protection systems, now known as Supercapacitor Assisted (SCA) techniques was developed. These patented SCA techniques such as SCA-low dropout regulator (SCALDO), SCA-surge absorber (SCASA), SCA-temperature modification apparatus (SCATMA) and SCA-LED are based on a new theory now published as SCA loss management (SCALoM) theory. The tutorial will present how we can develop extra low frequency DC-DC converters (based on SCALDO), high performance transient surge absorbers (based on SCASA) and high efficiency DC lighting (SCALED based) in addition to how this new approach could help in new directions for DC homes and DC appliances etc.

3. Short biography of tutorial lecturer including photo (can be attached separately)

Nihal Kularatna

DSc, BSc Eng (Hons)

FIET (London), FEngNZ, Senior Member IEEE (USA)

Nihal Kularatna is an electronics engineer with over 48 years of contribution to profession and research. He has authored ten reference books for practicing electronic engineers including the two consecutive IET Electrical Measurement Series books titled *Modern electronic test & measuring instruments* (1996) and *Digital and analogue* i*nstrumentation-testing and measurement (2003/2008)* and five Elsevier (USA) titles. His latest research monograph on sustainable energy and energy storage systems, titled *Energy Storage Devices for Renewable Energy Systems: Rechargeable Batteries and Supercapacitors,* was published by Elsevier in June 2021, summarizing his applications-oriented research during the last five years, supervising many PhD students at the University of Waikato, New Zealand. He was the winner of **New Zealand Engineering Innovator of the Year 2013 Award**. In 2021, he won the Postgraduate Research Supervision Staff Excellence Award. He was the first full-time CEO of the Arthur C Clarke Institute for Modern Technologies

A Fellow of the IET (London), Fellow of Engineering NZ and a Senior Member of IEEE (USA) and a graduate from the University of Ceylon, during his industrial career at the Arthur C Clarke Institute for Modern Technologies, he was a winner of Presidential Awards for Inventions-1995, the Most Outstanding Citizens Awards-1999 and a TOYP Award in 1993. In 2015, University of Waikato conferred him with a DSc degree for his thesis titled "Contributions to Power Management, Telecommunications and Telecommunications- A Three Decade Journey".

He is currently active in research in non-traditional supercapacitor applications, power supply topologies, transient propagation and renewable energy. He has contributed over 175 papers to learned journals and international conferences. His work on supercapacitor assisted (SCA) circuit topologies/techniques such as SCALDO, SCASA and SCATMA culminated numerous US, NZ and PCT patents.

He is presently employed as an Associate Professor in the School of Engineering, the University of Waikato, New Zealand. At international IEEE conferences and industry trade shows he frequently delivers invited tutorials, workshops and lectures on subjects he is passionate about, including the area of innovation and commercialization. His hobbies are gardening and car-grooming.

4. Keywords treated in the tutorial

1) Supercapacitor applications
2) Low frequency DC-DC converters
3) Transient surge protectors
4) DC lighting
5) DC white goods/DC homes
6) Energy efficiency