CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE · INDIA

Notice for the PhD Viva-Voce Examination

Ms Nirmala John (Registration Number: 1447401), PhD scholar at the School of Engineering and Technology, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Monday, 12 August 2024 at 10.00 am in the CDI Conference Room, III Floor, Block V, Bangalore Kengeri Campus, Bengaluru - 560074.

Title of the Thesis	:	**Multi-Objective Optimization Approaches for Solar Photovoltaic Inverter Control and Energy Balance in a Smart Grid Environment**
Discipline	:	**Electrical and Electronics Engineering**
External Examiner (Outside Karnataka)	:	**Dr D M Vinod Kumar** Professor Department of Electrical Engineering National Institute of Technology Warangal Hanamkonda, Warangal - 506 004 Telangana State
External Examiner (Within Karnataka)	:	**Dr Dattatraya Narayan Gaonkar** Associate Professor National Institute of Technology Karnataka (NITK) Surathkal, Srinivasnagar Post, Mangalore - 575025 Karnataka
Supervisor	:	**Dr Varaprasad Janamala** Associate Professor Department of Electrical and Electronics Engineering School of Engineering and Technology CHRIST (Deemed to be University) Bangalore Kengeri Campus Bengaluru - 560074 Karnataka
Co-Supervisor	:	**Dr Joseph Rodrigues** Professor Department of Electrical and Electronics Engineering School of Engineering and Technology CHRIST (Deemed to be University) Bangalore Kengeri Campus Bengaluru - 560074 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 05 August 2024

ABSTRACT

To keep up with the growing need for electricity around the world, electrical distribution systems (EDS) now need to be self-healing, interoperable, and resilient. This can be done with the help of clean sources of renewable energy (RE) as distributed generation (DG), connected to the power grid. Additionally, the smart grid (SG) environment has aided changes in power distribution. Automation technologies are increasingly transforming traditional distribution systems into smart distribution systems that provide distribution operators with remote control for consistent and reliable supply. RE-based DG sources must be properly positioned and sized to avoid bidirectional power flows and performance degradation. Solar Photovoltaic Systems (SPVS) are potentially becoming the preferred DG source, and the number of utility-owned plants is increasing. The utility, as an energy distributor, is primarily interested in technical benefits, but it also aims for economic benefits. Thus optimal solutions for designing and operating utility-owned SPVS systems are required. The energy industry is transitioning from centralised to distributed energy generation as well as towards a more consumer-centric and participatory energy market. Electric power utilities must meet system load at the lowest possible cost, while maintaining supply continuity and quality. However, most EDS have high R/X ratio and radial layouts, which cause considerable distribution losses, a low voltage profile and poor voltage stability margins. Integration of RE-based DG sources into the EDS should aim to tackle these issues. Most existing RE-based DG sources are not designed to supply reactive power for radial EDS. But DG sources with reactive power capability can reduce the reactive power dependability on the grid and voltage regulation devices and also allow for successful islanded operation, meeting real and reactive power demands.

In response to the above research question, this study looks at the best way to integrate SPVS systems into radial EDS and the best way to control the inverters to improve their performance in grid-connected mode. Also, it suggests using optimal load control (OLC) in a SG environment to find energy balance even when the system is in islanded mode. In both stages, effective heuristic methods have been used to solve the suggested multi-objective functions, which have different operating constraints and limits on energy consumption. The most recent versions of the Teaching Learning Optimization Algorithm (TLBO), called Learning Enthusiasm based TLBO (LebTLBO) and Adaptive Inertia Weight TLBO (ATLBO), have been used to solve the complex nonlinear multivariable optimization problem identified. These methods have been used to find solutions for optimal SPVS integration with inverter control for real and reactive power support as well as for optimal load control (OLC) in SPVS-integrated distribution systems in an islanded situation. For various scenarios, the effectiveness of the suggested techniques has been analysed on the IEEE 33-bus and 69-bus radial EDS, and the outcomes have been compared with the literature. The significantly improved performance of radial EDS under both grid connected and islanded modes, satisfying both operational limitations and consumers' satisfaction, highlights the adaptability of this research finding to real time applications.

Keywords: Photo Voltaic systems, DG Integration, Inverter Control, Microgrid, Load Control

Publications:

1. **Nirmala John**, Varaprasad Janamala and Joseph Rodrigues, "An adaptive inertia weight teaching–learning-based optimization for optimal energy balance inmicrogrid considering islanded conditions," Energy Syst, 2022, https://doi.org/10.1007/s12667-022-00526-3
2. **Nirmala John**, Varaprasad Janamala, Joseph Rodrigues, "Optimal Load Control for Economic Energy Equilibrium in Smart Grid using Adaptive Inertia Weight Teaching Learning Based Optimization," International Journal of Intelligent Engineering and Systems (IJIES), Vol 15, No. 2, pp. 243-250, Apr. 2022.
3. **Nirmala John**, Varaprasad Janamala, Joseph Rodrigues,"Optimal Allocation of Solar PV Systems for Enhancing Radial Distribution System Performance Using TLBO Algorithm,"Helix, vol.10 , no.2, pp.195-202, 2020