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Notice for the PhD Viva Voce Examination

Ms Neha Thakur, Registration Number: 1982605, PhD Scholar at the Department of Electronics and Communication Engineering, School of Engineering and Technology, CHRIST (Deemed to be University) will defend her PhD thesis at the public viva-voce examination on Monday, 18 May 2026 at 10.30 am in CDI Conference Room, III Floor, Block V, Bangalore Kengeri Campus, Bengaluru 560074, Karnataka, India.

Title of the Thesis	:	**Numerical Analysis and Formulation of NiOx-Based Nanocomposite Inks for Thin Film Deposition by Direct Ink Writing**
Discipline	:	**Electronics and Communication Engineering**
External Examiner - I	:	**Dr Ratna Kumar Annabattula** Professor Machine Design Section Department of Mechanical Engineering Indian Institute of Technology Madras Chennai - 600036 Tamil Nadu
External Examiner - II	:	**Dr Upendra Kumar Pandey** Associate Professor Department of Electrical Engineering Shiv Nadar Institution of Eminence (Deemed to be University), Gautam Buddha Nagar Uttar Pradesh - 201314
Supervisor	:	**Dr Hari Murthy** Assistant Professor Department of Electronics and Communication 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 (Academics)

Place: Bengaluru
Date: 17 April 2026

ABSTRACT

A paradigm shift is seen in the composite ink formulations incorporating nanostructures, enabling their use across several technologies, including but not limited to printed electronics, thereby heralding a significant revolution in electronic technology. To understand the ink properties, the research was carried out in three phases: numerical, simulation, and experimental work.

The experimental work commences with the synthesis of nanostructures, followed by the formulation of nanoinks and direct ink writing on substrates to fabricate films. Nickel oxide (NiO) nanoparticles, graphene powder, and silver nanowires (AgNWs) were used to synthesize two nanocomposite inks- NiO-graphene and NiO-silver nanowires. Various compositions were tested to determine the optimal concentrations of the nanostructures for developing nanoinks- NiO (60 mg/ml), graphene (20 mg/ml), and silver nanowire (3 mg/ml). The inks were deposited as thin films onto glass substrates using a direct ink writing technique. The thin films were subsequently characterized for their surface morphology, optical, and electrical properties. The characterization results confirm the desirable chemical composition, particle size, bond information, surface roughness, band gap, and sheet resistance of the thin films. After achieving the desired properties, the thin films were deposited onto the interdigitated electrode (IDE) pattern (printed using silver nanoink) to fabricate gas sensors operating at room temperature. The gases considered for this study were nitrogen dioxide (NO2) and carbon dioxide (CO2), which are the primary pollutants in the atmosphere that continuously degrade the natural environment and surroundings. Prolonged exposure can lead to severe lung tissue damage, increased heart rate, dizziness, elevated blood pressure, coma, and may be fatal. In the proposed work, the thin-film sensors fabricated using nanocomposite inks exhibited an excellent response and recovery times of 9 s and 10 s for the NO2 sensor using NiO-graphene ink. The CO2 gas sensor, employing NiO-silver nanowire ink, demonstrates response and recovery times of 11 s each. The sensors were stable even after 100 days, demonstrating reliable and stable response characteristics

Keywords: *Nickel Oxide, Graphene, Silver Nanowires, Ink Synthesis, Composite Ink, Direct Ink Writing, Gas Sensing.*

Publications:

1. **Neha Thakur,** Hari Murthy, Sudha Arumugam, Neethu Thomas, Aarju Mathew Koshy, and Parasuraman Swaminathan. "Direct ink writing of nickel oxide-based thin films for room temperature gas detection." Journal of Semiconductors 46, no. 1 (2025): 012606.
2. **Neha Thakur,** Parasuraman Swaminathan, and Hari Murthy. "Mathematical model of nickel-graphene composite inks for jetting properties in inkjet printing." Malaysian Journal of Science (2024): 59-67.
3. **Neha Thakur,** Neethu Thomas, Aarju Mathew Koshy, Parasuraman Swaminathan, and Hari Murthy. "Formulation of Nickel Oxide–Graphene Composite Ink and the Fabrication of Thin-Film Electrodes Using Direct Ink Writing: Thakur, Thomas, Koshy, Swaminathan, and Murthy." Journal of Electronic Materials 53, no. 5 (2024): 2573-2582.
4. **Neha Thakur,** and Hari Murthy. "Simulation study of droplet formation in inkjet printing using ANSYS FLUENT." In Journal of Physics: Conference Series, vol. 2161, no. 1, p. 012026. IOP Publishing, 2022.