CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE | DELHI NCR | PUNE

Notice for the PhD Viva Voce Examination

Mr Prabin A, Registration Number: 2090195, PhD Scholar at the Department of Chemistry, School of Sciences, CHRIST (Deemed to be University) will defend his PhD thesis at the public viva-voce examination on Tuesday, 19 May 2026 at 10.30 am in Room No. 306, 3rd Floor, R&D Block, CHRIST (Deemed to be University), Bengaluru - 560029, Karnataka, India.

Title of the Thesis	:	**Electrochemically Modulated Extraction of Metals from Cemented Carbide Scraps and Its Application in Energy Storage Devices**
Discipline	:	**Chemistry**
External Examiner - I	:	**Dr B Ramachandra Bhat** Professor Department of Chemistry National Institute of Technology Karnataka Surathkal, Srinivasnagar – 575025 Mangaluru, Karnataka
External Examiner - II	:	**Dr Nikhil Dhawan** Professor Department of Metallurgical and Materials Engineering Indian Institute of Technology Roorkee Roorkee – 247667 Uttarakhand
Supervisor	:	**Dr Ajesh Vijayan** Assistant Professor Department of Chemistry School of Sciences CHRIST (Deemed to be University) Bengaluru - 560029 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: 15 May 2026

ABSTRACT

Recovery of cobalt from soft cemented carbide scraps is a critical challenge due to the limitations of conventional pyrometallurgical and hydrometallurgical processes, which are energy intensive, environmentally hazardous, and generate corrosive effluents. A novel electrochemical approach using deep eutectic solvents (DES) addresses these gaps by enabling a green, scalable process under mild conditions, achieving >99.9% cobalt purity while minimizing waste and eliminating aggressive chemicals. The innovation lies in the single-step electrodeposition of cobalt onto surface-engineered stainless-steel substrates, eliminating binders and slurry-based fabrication for energy storage devices. This direct integration produces binder-free supercapacitor electrodes with exceptional performance-

specific capacitance of 357 $F \cdot g^{-1}$, energy density of 44.8 $Wh \cdot kg^{-1}$, and robust cycling stability, outperforming conventional systems. Cobalt's unique redox properties make it highly suitable for single step recovery from wastes to direct fabrication for supercapacitor applications, enabling fast charge-discharge cycles and high energy density, critical for next generation energy storage. Comprehensive characterization using XRD, SEM-EDS, Raman spectroscopy etc. confirmed phase purity and morphology, while CV, GCD, and EIS validated superior electrochemical behavior. Additionally, a multi-step recovery route producing cobalt oxalate and cobalt oxide powders from cemented carbide sludge demonstrated high power densities (>2600 $W \cdot kg^{-1}$), showcasing versatility for advanced energy storage. By converting hazardous soft scrap into high value energy materials, this approach promotes a circular economy, reduces reliance on primary cobalt sources, and accelerates sustainable energy technologies.

Keywords: Cobalt recovery, Deep eutectic solvents, Electrochemical recycling, Cemented carbide sludge recycling, Supercapacitors, Circular economy, Sustainable energy storage, Electrochemical extraction.

Publications:

1. **Prabin, A.**, Sudhakar, Y. N., & Vijayan, A. (2024). Streamlined electrochemical harvesting of cobalt and nickel from soft cemented carbide scrap for superior supercapacitors. Electrochimica Acta, 497, 144588. https://doi.org/10.1016/j.electacta.2024.144588

2. **Prabin, A.**, Sudhakar, Y., & Vijayan, A. (2025). Electrochemical cobalt extraction from grinding sludge for supercapacitor applications via hydro- and solvometallurgical processes. Materials Chemistry and Physics, 130866. https://doi.org/10.1016/j.matchemphys.2025.130866