

**A**  
**Mini Project Report**  
**on**  
**"Development of Manganese Oxide-Doped Biomass-Derived Porous Carbon for Supercapacitor Applications"**

**Bachelor of Technology**

**In**

**Chemical Engineering**

**Submitted by -**

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**May 2025**

## **CERTIFICATE**

Certified that the Major Project Report entitled "**Development of Manganese Oxide-Doped Biomass-Derived Porous Carbon for Supercapacitor Applications**" submitted by Student name of B.Tech. 4<sup>th</sup> Semester, in partial fulfillment of the requirements for the award of degree in Bachelor of Technology (B. Tech) in Chemical Engineering, is according to the students their own investigation carried out by them in the Department of Chemical Engineering, School of Studies of Engineering & Technology, GGV, during the session 2024-25.

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# Abstract

This study explores an eco-friendly approach to developing high-performance electrode materials for supercapacitors using agricultural waste. Porous carbon was synthesized from coriander biomass through carbonization and chemical activation with KOH. The activated carbon (BPC) was further doped with manganese oxide ( $\text{Mn}_3\text{O}_4$ ) to produce Mn-BPC, aiming to enhance its energy storage capacity. Structural analysis revealed that BPC had a large surface area and porous structure, while Mn-BPC maintained this porosity and added redox-active manganese oxide particles, contributing to better electrochemical performance.

Electrochemical tests using a three-electrode system and 6 M KOH electrolyte showed that Mn-BPC combined electric double-layer capacitance (EDLC) with pseudocapacitance. It achieved a high specific capacitance of 482 F/g at 0.5 A/g, outperforming undoped BPC (385 F/g). Even at high current densities, Mn-BPC retained good capacitance and demonstrated excellent cycling stability. Electrochemical impedance spectroscopy confirmed improved ion transport and reduced charge transfer resistance.

A symmetric device using Mn-BPC electrodes delivered an energy density of 14.5 Wh/kg at 250 W/kg and successfully powered an LED, confirming its real-world application potential. Overall, this research highlights the value of combining biomass-derived carbon with metal oxide doping to create sustainable, efficient materials for next-generation supercapacitors.