डॉ. श्यामाप्रसाद मुखर्जी अंतर्राष्ट्रीय सूचना प्रौद्योगिकी संस्थान

Dr. Shyama Prasad Mukherjee International Institute of Information Technology, Naya Raipur

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<u>To Whomsoever It May Concern</u>

This is to certify that **Mr. Sagnik De** from University of Calcutta, Kolkata, West Bengal has successfully completed his winter internship under my supervision on the topic "IoMT-assisted advanced Deep Learning framework for Major Depressive Disorder (MDD) Diagnosis using EEG and Speech signals" during **4th December, 2023** to **10th May, 2024**, at *Biomedical and Speech Processing Lab*, Department of Electronics & Communication Engineering, International Institute of Information Technology (IIIT) Naya Raipur.

During this period, Mr. Sagnik demonstrated exceptional research aptitude, professionalism, and dedication. His work focused on **unimodal** neural signal modeling for **clinical MDD diagnosis**, leading to the development of SLiTRANet, a deep learning framework integrating Stockwell transform-based time–frequency analysis, Linear Graph Convolution Network (LGCN) for spatial–spectral connectivity learning, and a novel Transformer module for sequential neural dynamics modeling. To address class imbalance, he designed a weighted focal binary hinge loss, achieving state-of-the-art performance on the MODMA and HUSM EEG datasets, published in *IEEE Access, 2024*. He further extended this research to a **multimodal EEG–audio fusion framework**, introducing a **slice-based Vision Transformer** to process EEG time–frequency maps and Mel-spectrograms. The model employs a Parallel Transformer Encoder and Class Encoder to capture temporal and global dependencies, with fused features enabling accurate classification. This work was published in *IEEE Transactions on Computational Biology and Bioinformatics, 2025*.

What sets Mr. Sagnik apart is his ability to seamlessly bridge the gap between theory and application. He not only grasps complex concepts swiftly but also exhibits a rare talent for implementing them in real-world scenarios. His problem-solving skills, especially in *deep learning*, *IoT in healthcare*, *brain-computer interface* and *neural engineering*, were evident throughout the successful completion of this research work.

Mr. Sagnik consistently demonstrated creativity, intellectual curiosity, analytical rigor, and the ability to work independently while collaborating effectively with peers. His dedication, professionalism, and enthusiasm for research make him a valuable contributor to any scientific endeavor.

Please feel free to contact me for any further information.

Date: November 4th, 2025

Sincerely,

(Dr. Anurag Singh)