DECLARATION

This is to certify that the thesis entitled "***Development of composite conducting polymer with 2D layered and metallic nanosystems for biofunctionalization and electrochemical biosensing applications***" being submitted to the School of Sciences, Tezpur University, Tezpur, Assam in partial fulfilment for the award of the degree of Doctor of Philosophy in Physics is a record of bona fide research work accomplished by me under the supervision and guidance of Prof. Dambarudhar Mohanta.

All help received from various sources has been duly acknowledged. No part of this thesis has been submitted elsewhere for the award of any other degree.

Date: 31/07/2025

Place: Tezpur

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Dedication

I Dedicate this thesis to my beloved parents

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CERTIFICATE OF THE SUPERVISOR

This is to certify that the thesis entitled ***"Development of composite conducting polymer with 2D layered and metallic nanosystems for biofunctionalization and electrochemical biosensing applications"*** submitted to the **School of Sciences, Tezpur University** in partial fulfilment for the award of the degree of Doctor of Philosophy in Physics, is a record research work carried out by **Ms. Susmita Baruah** under my supervision and guidance.

All help received by her from various sources has been duly acknowledged. No part of this thesis has been submitted elsewhere for the award of any other degree.

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List of abbreviations

HOMO	:	Highest occupied molecular orbital
LUMO	:	Lowest unoccupied molecular orbital
PEDOT-PSS	:	Poly(3,4-ethylenedioxythiophene)-polystyrene sulfonate
PANI	:	Polyaniline
GO	:	Graphene oxide
TMDCs	:	Transition metal dichalcogenides
WS_2	:	Tungsten disulfide
AuNP	:	Gold nanoparticle
PVA	:	Polyvinyl alcohol
NMP	:	N-Methyl-2-Pyrrolidone
ITO	:	Indium tin oxide
IgG	:	Immunoglobulins G
BSA	:	Bovine serum albumin
GLU	:	Glutaraldehyde
Glox	:	Glucose Oxidase
AF-B_1	:	Aflatoxin B_1
XRD	:	X-ray diffraction
FTIR	:	Fourier Transform Infrared Spectroscopy
SEM	:	Scanning electron microscopy
EDX	:	Energy dispersive x-ray
CV	:	Cyclic voltammetry
EIS	:	Electrochemical Impedance spectroscopy
CPE		Constant Phase Element
PBS	:	Phosphate buffer saline
DPV	:	Differential pulse voltammetry
kD	:	Kilo-Dalton
POC	:	Point-of-care
FAD	:	Flavin adenine dinucleotide
LOD	:	Limit of detection

List of symbols

R_1	:	Solution resistance
R_{ct}	:	Charge transfer resistance
C_{dl}	:	Double layer capacitance
ω	:	Warburg impedance
Q	:	Constant phase element
Z'	:	Real part of impedance
Z''	:	Imaginary part of impedance
σ	:	Standard deviation
m	:	Slope
υ	:	Scan rate
D	:	Diffusion coefficient
A	:	Electroactive area
C	:	Concentration
i_p	:	Anodic peak current
i_c	:	Cathodic peak current
C_p	:	Capacitance