Dedicated

To

My Beloved Parents

Late Sreemati Sanjha Devi Yadav

And Late Shree Ram Rup Yadav

DECLARATION

I declare that the thesis entitled **"Interaction and Micellization Behavior of Surfactants with Polyelectrolytes in the Presence of Dyes in Aqueous and Binary Solvent Media"** has been prepared by me under the joint supervision of Prof. Dr. Biswajit Sinha, Department of Chemistry, University of North Bengal and Prof. Dr. Ajaya Bhattarai, Department of Chemistry, Mahendra Morang Campus, Biratnagar, Tribhuvan University, Nepal. No part of this thesis has formed the basis for the award of any degree or fellowship previously.

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PREFACE

I started my research work outlined in this thesis entitled "**INTERACTION AND MICELLIZATION BEHAVIOR OF SURFACTANTS WITH POLYELECTROLYTES IN THE PRESENCE OF DYES IN AQUEOUS AND BINARY SOLVENT MEDIA"** under the esteemed supervision of Prof. Dr. Biswajit Sinha (Department of Chemistry, University of North Bengal, India) and co-supervision of Prof. Dr. Ajaya Bhattarai (Department of Chemistry, Tribhuvan University, Biratnagar, Nepal) to investigate into surface, micellization, thermodynamic and spectral behavior of surfactants in the solution of polyelectrolytes with and without dyes by surface tension, UV-visible spectroscopy, and conductivity techniques. These properties can be studied by varying temperature and ethanol-water solvent composition. The knowledge of such properties in an ethanol-water solvent environment has industrial relevance and is frequently required in the theoretical and applied area of surface chemistry research and also provide valuable information about the spectral shift, binding behavior, CMC, maximum surface excess concentration (Γ_{max}), the efficacy of surface tension reduction (π_{CMC}), packing parameter (P), aggregation number (N_{agg}), and minimum surface area per surfactant molecule (A_{min}). These parameters also provide valuable insights into the degree of packing or packing density, orientation, and interaction at the surface, which are critical for understanding and optimizing the performance of surfactants in various applications and performance of surfactants across various fields like drug delivery, formulation science, nanotechnology and enabling the development of more efficient and effective surfactant-based formulations. A knowledge about the molecular interactions amongst the surfactant, dye, and polyelectrolyte can also be established by obtaining different thermodynamic and spectral parameters like critical aggregation concentration (CAC), critical micelle concentration (CMC), degree of dissociation (α), free energy of micellization (ΔG_m^o), binding constant (K_b), free energy of binding (ΔG_b^o), free energy of adsorption (ΔG_{ads}^0), etc. from the experimental data. Variation of these parameters provide the valuable informations about the nature, and spontaneity of the various processes occurring in the mixture of dye, surfactant, and polyelectrolyte. Therefore, research works embodied in this thesis will open up new avenues for the development of novel, environmentally friendly with enhanced yield and economy which will benefit the community.

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LIST OF ABBREVIATIONS

CAC	Critical Aggregation Concentration
CMC	Critical Micelle Concentration
PE	Polyelectrolyte
UV-Vis.	Ultravolilet-Visible
CTAB	Cetyltrimethylammonium bromide
NaPSS	Sodium polystyrene sulfonate
MR	Methyl red
DTAB	Dodecyltrimethylammonium bromide
MO	Methyl orange
V.F.	Volume fraction
SP	Solubilizing Power
S_P	Solvophobic parameter
PSC	Polyelectrolyte Surfactant Complex
K_b	Binding constant
ΔG_m^0	Standard free energy of micellization
ΔS_m^0	Standard free energy of micellization
ΔG_b^0	Standard free energy of binding
ΔS_{mb}^0	Standard free energy of bound

	micelle,
ΔH_m^0	Standard heat of micellization
ΔG_{trans}^0	Standard free energy of tail transfer
ΔG_{ad}^o	Standard free energy of adsorption
P	Packing parameter
Γ_{max}	Maximum excess surface concentration
A_{min}	Area occupied per surfactant molecule
π_{CMC}	Surface pressure at the CMC
α	Degree of dissociation
PEUF	Polyelectrolyte-enhanced ultrafiltration
G	Gordon parameter
D	Dielectric constant
E_T	Reichardt's parameter
λ_{max}	Maximum absorbance
$\mathbf{D_T}$	Total concentration of MR,
$\boldsymbol{\varepsilon_m}$	Molar extinction coefficient
$\mathbf{C_m}$	CTAB concentration in the micellized state
C_s	CTAB concentration within the studied concentration range

γ	Surface tension
γ_0	Surface tension of solvent
γ_{CMC}	Surface tension of solution
π_{CMC}	Surface pressure,
ΔG^0_{eff}	Effective Gibbs' energy
ΔG_{min}	Minimum Gibbs' energy
N_{agg}	Aggregation number
$P_{C_{20}}$	Adsorption efficiency
π_{CMC}	Surface tension reduction