Dedicated to my

Beloved parents

My Father - Mr. Jahar Lal Barman.

My Mother - Mrs. Sabitri Bala Barman.

And

My Brothers

DECLARATION

I declare that the thesis entitled **"PHASE TRANSITIONS AND PHYSICAL PROPERTIES OF SOME MESOGENIC COMPOUNDS AND THEIR BINARY MIXTURES"** has been prepared by me under the guidance of Prof. Malay Kumar Das, Department of Physics, University of North Bengal. No part of the thesis has formed the basis for the award of any degree previously.

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I certify that Miss Barnali Barman has prepared the thesis entitled "**PHASE TRANSITIONS AND PHYSICAL PROPERTIES OF SOME MESOGENIC COMPOUNDS AND THEIR BINARY MIXTURES**", for the award of Ph.D. degree in the University of North Bengal, under my guidance. She has carried out the work at the Department of Physics, University of North Bengal and this work has not been submitted elsewhere for a degree.

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b66786c2-7633-40a6-bcba-d3bb9cfe1879
https://arxiv.org/pdf/1104.5670
https://www.researchgate.net/publication/244589685_Critical_behaviour_of_the_order_parameters_at_the_SmC_to_SmA_phase_transition_in_a_ferroelectric_liquid_crystal_mixture
https://www.datasheetarchive.com/smc%2045100-datasheet.html
https://docplayer.com.br/123543544-Joule-heating-effect-for-erasing-information-in-pdlcs-devices-with-memory.html
https://kundoc.com/pdf-smectic-asmectic-csmectic-c-lifshitz-point-in-mixtures-of-chiral-and-achiral-sme.html
https://www.researchgate.net/publication/263385486_Polar_and_tilt_modes_in_the_ferroelectric_SmC_phase_in_liquid_crystals
https://www.researchgate.net/publication/307605664_Thermodynamic_Optical_Electrical_and_Electro-optical_Features_of_a_Room_Temperature_Nematic_Liquid_Crystal_Dispersed_with_Single_Walled_Carbon_Nanotubes
https://www.researchgate.net/publication/231103637_A_simple_molecular_theory_of_smectic-C_liquid_crystals
https://www.researchgate.net/publication/44670039_Systematic_Variation_of_Length_Ratio_and_the_Formation_of_Smectic_A_and_Smectic_C_Phases
https://www.researchgate.net/publication/233311662_The_Critical_Behavior_of_the_Order_Parameter_and_Susceptibility_Near_Smectic_A-Smectic_C_Phase_Transition
https://www.researchgate.net/publication/344045550_Liquid_Crystals_ISSN_Print_Online_Journal_homepage_httpswwwtandfonlinecomloitlct20_Boost_in_the_thermal_stability_ionic_conductivity_and_director_relaxation_frequency_in_the_composite_of_liquid_crysta
https://www.researchgate.net/publication/257307116_Antiferroelectric_Liquid_Crystals_Smart_Materials_for_Future_Displays

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https://www.researchgate.net/publication/12278936_Electroclinic_liquid_crystals_with_large_induced_tilt_angle_and_small_layer_contraction
https://www.researchgate.net/publication/233469903_Ferroelectric_Liquid_Crystals_A_Review
https://epdf.pub/handbook-of-liquid-crystals-3-volume-set.html
https://www.researchgate.net/publication/303502131_Effect_of_chain_length_and_fluorination_on_the_dielectric_and_electro-optic_properties_of_three_partially_fluorinated_biphenylyl_benzoate_rigid_core_based_ferroelectric_liquid_crystals
https://www.researchgate.net/publication/233171097_Soft_mode_and_related_behaviour_in_the_SmA_and_SmC_phases_of_a_ferroelectric_liquid_crystalline_polymer_by_dielectric_spectroscopy

Instances where selected sources appear:

95

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It is certified that the work contained in the thesis titled **"PHASE TRANSITIONS AND PHYSICAL PROPERTIES OF SOME MESOGENIC COMPOUNDS AND THEIR BINARY MIXTURES"**, by **Miss Barnali Barman** has been carried out following University guideline and has been approved by the Departmental Research Committee for processing by the Board of Research Studies.

Approved: Date:

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PREFACE

The thesis entitled **''Phase transitions and physical properties of some mesogenic compounds and their binary mixtures''** is devoted to the work in the field of liquid crystalline research under the supervision of Prof. Malay Kumar Das, Department of Physics, University of North Bengal. The motivation behind this work is the growing interest of the liquid crystalline (LC) compounds in various applied fields. The entire thesis consists of eight different chapters. The first Chapter covers a brief introduction about the background to the general topics of liquid crystals. In Chapter-2 a concise theoretical as well as the experimental procedures associated to this work have been discussed. Chapter-3 to Chapter-6 thoroughly highlight on the study of the behaviour of the achiral and chiral liquid crystalline phase transitions. Chapter-7 and Chapter-8 explain electro-optical and dielectric properties of some pure chiral ferroelectric liquid crystalline compounds (FLCs) and their binary mixtures for better understanding of the molecular structure-property correlations and for proper tuning of the different physical properties. These pure chiral ferroelectric liquid crystalline compounds and their bi-component mixtures are very useful in the optoelectronic and photonic applications. At the end of this thesis all the concluding remarks are taken from each chapter and the future scope has also been discussed.

This whole journey of this research work was very much interesting and helpful for me. In this course of study my self-learning capacity has been grown day to day and I have learnt many important things about the liquid crystalline field of research. This work gives me an opportunity to understand in an easy way by using many sophisticated experimental procedures. Although, numerous studies are going on both experimentally and theoretically in this field of research; still there are many unresolved phenomena which necessitate further investigations. It is believed that this work should provide some contribution towards the experimental investigation on the phase transitional behaviour and physical properties of various liquid crystalline compounds and their binary mixtures.

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