ACKNOWLEDGEMENTS

As a research scholar I have worked with many peoples whose contributions in assorted way to research and the making of the thesis deserve individual mention. I take this opportunity with much gratification to express thank all the people who have helped me during the course of my expedition towards this thesis.

I bow my head to the Almighty God, showing me inner peace, blessings and providing me the opportunity to step in the excellent world of science and guided me to accomplish the great task of research and without which I could never have overcome the hurdles and complete this endeavor successfully.

With sincerity and immense pleasure, I express my heartfelt gratitude to my benevolent supervisor Dr. Ritu Mahajan, Associate Professor, Department of Biotechnology, Kurukshetra University, Kurukshetra, for giving me the opportunity to work under her esteemed guidance and developing myself in many directions during my doctoral studies. I am especially indebted for her patience in handling my shortcomings, which have helped me immensely towards developing my research skills. Her generosity, affection and understanding will always remain engrained in my memory. I am really blessed to get an opportunity to work under her guidance. I owe her lots of gratitude for having me shown this way of research. Her overly enthusiasm and integral view on the research and her mission for providing high quality work has made a deep impression on me. Above all and the most needed, she provides me unflinching encouragement and support in various ways. I am thankful to Almighty God, who provided me supervisor like you. In the same place, I would like to record my gratitude to my Co-Supervisor Dr. Jitender Sharma, Chairman and Professor, Department of Biotechnology, Kurukshetra University, Kurukshetra, for his support and guidance. I appreciate all his contributions of time, ideas and motivation to make my Ph.D. experience productive. His advice and unsurpassed knowledge exceptionally inspired and enriched my growth as a researcher.

I articulate my gratitude to Honourable Vice-Chancellor, Lt. Gen. (Dr.) D.D.S. Sandhu for providing excellent infrastructural facilities at the Department of Biotechnology, Kurukshetra University, Kurukshetra. I am also grateful to the Dean,
Faculty of Life Sciences, Dr. Girish Kumar Chopra for his kind interest and cooperation. It is a great privilege for me to express my esteem and profound sense of gratitude to Dr. Rishi Pal Mandhan, Professor, Department of Biotechnology for his encouragement and support during the research work.

I express my sincere thanks to Dr. Anita Yadav, Dr. Raman Saini, Dr. Sanjeev Gautam, Dr. Sunita Dalal, Dr. Bindu Battan and Dr. Sulekha, faculty members, Department of Biotechnology, Kurukshetra University, Kurukshetra for their valuable help and encouragement during the entire period of research. Financial support provided by University Grant Commission (UGC), New Delhi, India in the form of MANF by UGC is greatly acknowledged.

I express my special thanks to non-teaching staff of the Department of Biotechnology for their full co-operation during research.

I wish my sincere thanks to Dr. Ravi Dutt Yadav, Assistant Manager, Ballarpur Industries Limited (BILT), Yamuna Nagar, Haryana and Dr. Arun Kumar Patra, Department of Textile Chemistry, TIT&S, Bhiwani, for their valuable guidance and continuous support during my research work.

I am deeply grateful to my seniors Dr. Sampriya Sharma, Dr. Suman Malik, Dr. Ajay Kansal, Dr. Aparana, Dr. Kapil Dev, Dr. Shiv Kumar Giri, Dr. Anil Kumar, Dr. Gaurav Garg, Dr. Pooja Bharti, Dr. Rajan Chopra and Dr. Amanjot Kaur. Their contribution at various levels of my research work was beyond words of recognition. They provide good and motivating work atmosphere and the time spent with them will always remain as a wonderful memory in my mind. I convey my heartiest thanks to Mrs. Richa Gautam and Mr. Sharad for their support and cordial environment in the laboratory throughout my research program. Special thanks to Mr. Neeraj and Ms. Ankita for offering me a generous help, motivation and co-operation whenever needed.

I am also thankful to Anil Khuttan, Ashutosh, Ekta, Anupama, Leena, Sheema, Sachin, Kanupriya, Neha and Libin for their support during the study. Thank you all for being compassionate.
I would not be able to complete my research work without my family. I find words inadequate to express my feeling and gratitude to my wonderful parents, S. Mani Singh and Mrs. Jarnail Kaur who have guided and helped me from day one of my life. My special gratitude to my brothers Sukhbir Singh and Nachhatar Singh for having faith in me and encouraging me in all my endeavors. Words fail me to express my appreciation to my wife Mrs Kawaljeet Kaur whose efforts during the final stages of my Ph.D. which I can’t forget in my lifetime.

Finally, I take this opportunity to thank one and all who have directly or indirectly helped me in completing this task as well as express my apology for those names that I could not mention individually.

Thank you all.

Date:

Place: Kurukshetra