The writing of the thesis has been one of the most significant academic challenges. This dissertation would not have been possible without the guidance and the help of several individuals who in one or another way have contributed and extended their valuable help in the preparation and completion of this study. It is to them that I owe my deepest gratitude.

At the very onset, I am humbly indebted to my supervisors- Prof. A.S. Dhaliwal and Prof. R.G. Sonkawade, for their invariable guidance and supervision. They interleave in me the sense of responsibility, sincerity & talent to work and have been instrumental shaping in many ways my professional and social life. They inspired me to work with strong determination and dedication under adverse situations. I have been blessed by their kind support, valuable inputs and suggestions when I needed the most.

It is a pleasure to express my gratitude wholeheartedly to Prof. M D Shirsat, Intelligent Materials Research Lab, Dr. BAM University Aurangabad, Prof. S Annapoorni, Department of Physics, University of Delhi and Prof. S K Chakarvarti, Manav Rachna International University, Faridabad, for their scientific discussions and suggestions. They taught me new concepts and ways to explore the work towards fruitful conclusions and have offered much advice and insight throughout my work.

I wish to extend my sincere thanks to the Director, Inter University Accelerator Centre (IUAC), New Delhi, for providing the experimental facilities time-and-again to carry out this research work. I fully acknowledge the directions and the orientations recommended by Dr. Rohit Mehra, Deptt. of Physics, NIT Jalandhar who actually motivated and introduced me to join the research facilities at IUAC, New Delhi.

I am very thankful to Dr. Fouran Singh, Dr. SP Lochab, Dr. Pawan Kulriya, Dr. Kanjilal, Dr. DK Avasthi and Mr. Birendra Singh for extending their kind support at all times. I also wish to thank the Pelletron Staff of IUAC for their assistance during the beam time experiment. I convey my special thanks to Prof. Ravi Kumar, Centre for Material Science & Engg., for his generous advice and making available the lab facilities at NIT Hamirpur.
I am privileged to get the invaluable inputs, constructive suggestions and kindness from all the esteemed Faculty & Staff Members of Physics Department, SLIET Longowal during my Ph.D.

I had the pleasure to work with many young Scientists. In particular, I would like to thank Dr. DC Agarwal, Dr. Jai Prakash, Dr. OP Siwach, Dr. GBS Lakshmi, Dr. Subhash Pokhriyal, Dr. YK Mishra and Dr. Yogesh Kumar for their inspiration and constant help.

I express my earnest gratitude to Sh. SG Vaijapurkar and Dr. Pradeep Kumar, Scientist, Defense Laboratory, DRDO, Jodhpur for providing the irradiation facility. My sincere thanks go to all my friends for their encouragement, help and useful suggestions throughout the course of this study.

I will fall short of words to express my affluent feelings to my joint family members for their inspiration, infinite moral support, patience and faith in me to pursue higher studies. Especially, I recognize the contributions of my elder brother Er. Ashwani Sharma, whose constant behind-the-scenes efforts prepared me to reach this stage in life. It was under his watchful eye that I gained so much drive and an ability to tackle the challenges head on.

I would also like to thank my in-laws for all their profound affection, concern and understanding. A special credit goes to my wife Kashma for being supportive, emotional and caring at all times.

Last but by no means least, I would like to place on record my deep regards to my beloved parents for their endless love, care and blessings in all endeavours. Words would not be sufficed for all of the sacrifices that they have made for me.

I am most grateful to the Ministry of Human Resource & Development (MHRD), New Delhi for rendering the financial help (Institute Fellowship) during my Ph.D.

Above all, I owe and dedicate everything to the Almighty GOD for the strength that keep us standing and for the hope that keep us believing.

To those who indirectly contributed in this research, your kindness means a lot to me. Thanks to all of you!

(Vijay Kumar)