Acknowledgements

First of all, I would like to express my heartfelt gratitude to the ALMIGHTY HANUMANJI and my Guruji Pandit Gokul Prasad Tiwari for bestowing me with everything, and because of whose grace I could accomplish my research task with success.

I am highly thankful to my loving parents, younger brother Kirtiman and my sisters Akanksha and Sarika for their continuous support, sacrifice and unconditional love which made my journey of PhD beautiful, enjoyable and memorable. I would also like to thank my Buaji Mrs Swadeep Dutta and Jijaji, Mr Aditya Pandey, for his support.

It is the moment of great pleasure and immense satisfaction for me to express reverence to my guide, Dr. Om Prakash Katar, for his dextrose guidance, and unflagging encouragement. His overfly enthusiasm and integral view on research has made a deep impact on me. In fact, his valued suggestions, precious guidance, generous help, constructive criticism, and benevolent attention, which it would not have been possible for me to execute this novel project efficiently and successfully.

Debt of graduate goes to Professor Bhupinder Singh Bhoop, for furnishing impetus and torrent of astuteness. He patiently provided the vision, encouragement and advice necessary for me to proceed through the doctoral programme and complete my PhD thesis. I want thank Professor Bhoop for his unflagging inspiration for the search of the "optimized approach", both in research as well as in life. He has been a strong and supportive adviser to me throughout my PhD research and always motivated me to perform the "best". Thanks a lot sir for helping and guiding me.

I express my thankfulness to Professor V R Sinha, Chairperson of the Institute for his words of encouragement, timely support and providing the facilities to carry out my research work.

Gratitude to Professor S P Vyas, Dr. H.S. Gour University, Sagar, Madhya Pradesh, for introducing me to the world of vaccine delivery at my post graduation level and supporting me in all aspects of research carrier.

Thanks to all the teachers especially Professor Karan Vasisht, Professor A. R. Rao, Professor Indu Pal Kaur, Professor Sishu, Professor Kanwaljit Chopra, Professor Renu Chadha, Professor Manoj Kumar, Professor Anupam Sharma, Professor Ranju Bansal, Professor Poonam Pipani, Professor Anil Kumar, Ms. Alka Bali and Dr.
Maninder Karan for the support. I am also thankful to Neelima Madam for his support and affection.

I would like specially thank to Dr. Sashi Bhusan, Scientist, IIHM, Jammu, for his help and timely support.

Special thanks to Usha Madam for her constant support and blessings during my PhD.

Thanks to Maninder Madam (CPEBS), Ranjit Kaur Madam, Mr Devlal (DST-FIST Lab), Dinesh Sharma Sir (CIL), Avtar Singh Sir (CIL) and Mohinder Singh Sir (CIL) for their continuous support and help in various analytical and characterization studies. Thanks to Dr Dutta, Medicos Lab., for the histopathological evaluations.

I am also thankful to Dr Sanyog Jain Sir, NIPER, for all the help and support.

Thanks are also extended to my worthy seniors, Dr Amit Bhatia, Dr Rishi Kapil, Dr Deepak Kapoor and Ms Bhawna Jain for their support. My special gratitude to Amit Bhatia Sir for being such a nice and great senior.

My journey of PhD was beautiful and lively because of my labmates, Mr Kaisar, Mr Basant, Mr Sarwar, Mr Rishi, Mr Neeraj, Mrs Poonam, Ms Sheetu, Mr Gajanand and Mrs Babita. Sarwar, it would have been difficult to deal with PhD without your help. Company of Kaisar Sir was enjoyable and worth learning. Thanks to Poonam and Sheetu for their support and bearing with my jokes and comments.

I would specially thank Basant Sir for all the enjoyable moments, love and friendship without you my life at IIHM would not have been so pleasant.

I am also thankful to my best friends, since my school and University days in Sagar, Harsh, Peeyush, Gaurav, Anurag, Sahil, Nitin and Vikas for their tremendous support, help and love. Thanks a lot for being there whenever I needed.

I am highly thankful to two of my best friends, in Chandigarh, Bimal and Anupama for their timely help, support, friendship and advices for making me a better friend and human being.

I would like to specially thank, my friends Abhimanyu, Prabhleen, Manleen, Ratandeep, Tania, Shelly, Vandana, Ankita, Sahil and Pankaj for the most enjoyable moments of my lifetime. Thanks a lot for making me feel so special. Thanks
all of you for your love, affection, care and laughs which made my life full of pleasant memories.

Special thanks to Hani, Vandna and Yukhti for making me laugh at times when it was not possible. Their comments, mimicry, laughs, enjoyment, affection, care and friendly nature made my last year of PhD memorable and enjoyable. Thanks a lot to all three of you.


Thanks to my juniors, Jayati, Ankit, Anurag, Nirupika, Ramanpreet, Kriti, Hitesh, Lohit, Tanya, Sukhneeraj, Ashna, Navjot, Dhirendra, Preeti, Harman, and Manmeet for their smiles, support and help.

Dr. Sukheet Singh, Panacea Biotech, Lalru, Panjab, for providing gift sample of antigens.

UGC, New Delhi for awarding UGC-RFMS fellowship, Bill and Melinda Gates Foundation for Global Health Travel Awards and PU syndicate for felicitation is highly acknowledged.

Thanks to technical and non-technical staff of UIPS especially Mr Chaman Lal, Mr Karam Singh (retd.), Mr Shaadi Lal, Mr Ravinder, Mr Dhruv, Mr Ram Das, Mr Anil Kumar, Mr Swarup, Mr Buta Singh, Mr Ajay, Mr Sham Singh, Mr Dayal Chand and Mr Sahib Singh.

Thanks to office staff Ms Kusumlata, Mr Kaundal, Ms Indra Rani, Ms Suman Bala, Mr Ram Kumar, Ms Jaspal Kaur Ms Mandep Bhatia, Ms Rajni, Mr Sumit, Mr Sandeep, Chetman Ji, Puspa Madam, Ram Rattan Uncle and Mr Dinesh for speedy processing of my documents.

Those experimental animals who laid down their lives in making my research endeavor successful may GOD grant them eternal peace.
In the end, I am sorry if I have missed some names in the acknowledgment, though they helped and supported me. Thanks to all of them who supported me throughout my research tenure and stay in Chandigarh.

Anshuman Shukla