

ACKNOWLEDGEMENT

I am highly indebted to the faculty of University of Petroleum and Energy Studies (UPES) for giving me the opportunity to undergo the Part-Time PhD program. The journey over five years was a great memoir for me as a research student. I am grateful to my guide Dr. Kamal Bansal for providing guidance for my research studies with constant support and encouragement.

Overwhelming guidance and enthusiastic advice was received from the external guide Dr. S. Sakthivel, Technology Group, TATA Consulting Engineers (TCE), Mumbai. His support was timely in all the phases during my research studies.

My humble salutations for the gesture of the management of SRM University, Chennai for their kind approval to perform the research tests within the campus. My sincere gratitude goes to Dr. John D Thiruvadigal for supervising the experimental setup, research test and providing guidance for disseminating the research.

This work is a tribute to my wife Ms. Nidhya (Late), who was very supportive to pursue research studies during the initial stages of this journey.