Mr. Harpreet Singh Grewal, research scholar, in SMME, IIT Ropar and Mr. Hemant Kumar, research scholar in Department of Chemistry, IIT Ropar.

A sense of gratefulness is due to Mr. Amit Kumar and Ms. Narinder Kaur of IIT Ropar for extending their support to perform XRD and FE-SEM/EDS and X-ray mapping analysis respectively. The author is also thankful to Mr. S.D. Sharma and Mr. Shiv Kumar of Institute Instrumentation Centre (IIC), IIT Roorkee for extending their support to perform XRD and FE-SEM/EDS analysis. Special thanks to Mr. Ram Kumar and Mr. Rajiv Kumar, technicians in Materials Science Laboratory, IIT Ropar, for their help and assistance during the in-vitro experimental work. The author wishes to thank the authorities of Metallizing Equipment Company Pvt. Ltd, Jodhpur for providing facilities for getting high-velocity flame sprayed coatings. The author is also grateful to the management of Gulzar Group of Institutes, and fellow colleagues for their co-operation during the period of his research work.

Finally, the author would like to thank his friends and family for their encouragement and understanding. Special thanks to his beloved parents, especially his father for his efforts to provide priceless opportunities to author’s family. The author expresses heartfelt thanks to his loving wife Amandeep Kaur, for her patience, encouragement and understanding throughout his PhD work. She deserves special applause for everything that she has done at each and every stage of this research work. The author will always remain indebted to his loving son Aditya, who always waited for author’s company during these years. The author finds no words to thank his sister Manpreet Kaur for her support during this period of work.

The author humbly dedicates this work to his brother-in-law Late S. Reetmohinder Singh Kullar. It’s unfortunate that he is not here to see this achievement. The author would like to express his gratitude to all those who gave direct and indirect support to complete this thesis. Finally, and above all, praise is due to Almighty God for His everlasting blessings and guidance in completing this research work.

(TEJINDER PAL SINGH SARAO)
Metals and alloys are used as bio-implants in human body for several clinical applications due to their excellent mechanical properties and reasonable biocompatibility. However, these materials suffer from corrosion, which is a serious problem, because it can adversely affect the biocompatibility and mechanical integrity of implants. Research and development on metallic biomaterials has shown that surface coating is a widely accepted alternative to minimize the harmful effects of corrosion.

In the present research work, a proprietary high-velocity flame-spray system has been used to deposit hydroxyapatite (HA) coatings on two bio-implant materials. Two different HA particle size powders, 10 \( \mu \text{m} \) (referred as HA-A powder) and 30 \( \mu \text{m} \) (referred as HA-B powder) were used in this study. Four different types of coating compositions, namely HA-A, HA-B, HA-TiO\(_2\) composite, and HA/TiO\(_2\) bond coatings were deposited on 316L SS and Ti-6-4 substrate materials. HA-A powder was mixed with TiO\(_2\) powder in 50:50 wt% for formulating HA-TiO\(_2\) composite coatings. In HA/TiO\(_2\) bond coatings, TiO\(_2\) was used as a bond coat between HA-B top coat and the base substrate material.

The coatings were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM)/energy-dispersive X-ray spectroscopy (EDS) analyses. Bond strength of the flame sprayed coatings has been determined as per ASTM-C633 standard. The corrosion behavior of the coatings was studied by electrochemical corrosion testing in simulated human body fluid. After the corrosion testing, the samples were analyzed by XRD and SEM/EDS analyses. The biological behavior was investigated by the cell culture studies using osteosarcoma cell line KHOS-NP (R-970-5).

Except the HA-A coatings which showed amorphous phases, all the other deposited coatings showed crystalline structure. The addition of TiO\(_3\) effectively improved the crystallinity of HA-A in HA-TiO\(_2\) coating on both 316L SS and Ti-6-4 substrate materials; otherwise, the HA-A coating was amorphous. The coating structure was mainly composed of HA and TiO\(_2\) (rutile) phases in HA-TiO\(_2\) coatings. Besides the crystalline HA and TiO\(_2\) phases, as-sprayed coating consists of minor TCP and TTCP phases, but no chemical