Friction welding is a simple and old technique in solid state welding, which is highly suitable for similar and dissimilar metal joining processes, which are involved in the manufacture of many industrial components. Nowadays this technique is improved to join many dissimilar materials by using interlayer techniques and faying surface geometry. These dissimilar materials find extensive use in aeronautics, automobile, nuclear, and power industries, due to its lightweight, excellent corrosion resistance, high strength level, and attractive fracture behaviour.

In this research work, two different dissimilar materials, namely Ti-6Al-4V and Stainless steel 304L were used as base materials. These base materials were joined with the help of Oxygen Free Copper (OFC) as an interlayer material. Based on the literature survey, cost of materials, and potential of modern uses, the predominant parameters were selected and used for fabricating the joint. Processing time and the strength of the joints were identified from this investigation of metal loss.

This research work is divided into two phases. The first phase concentrates on accomplishing the joint, using method 1, which is a two joint process. The outcome of this work was further evaluated by mechanical, metallurgical and elemental analyses. In phase 2, the experimental work was further extended for developing a novel method of holding the interlayer material and accomplishing the joint in single setting (Method 2) for minimising the processing time. This research work proved that joining of Ti-
6Al-4V and stainless steel 304L in single setting is successful with a new method of adding interlayer friction welding process.

Mathematical models have been developed for forecasting the mechanical properties of a friction welded Ti-6Al-4V/Cu/SS304L joint through use of the novel method of holding an intermediate metal. The experimented and predicted results have a very close correlation with 0.9 coefficients of determination. The above two methods are compared with respect to the processing time, the strength of the joint, metallurgical changes and diffusion of interlayer materials. The process was simplified through the development of a novel method for holding a copper coin as interlayer material and the processing time was drastically reduced by 50%. The metal loss of the base metal was minimum thereby, reducing the cost of metal by 25% to 30%. Due to the narrow heat affected zone, the base metal was not much affected and the interface did not result in formation of a hard interface region, the diffusion bonding of Ti-6Al-4V and SS304L rods were also compared with the friction welding, for its strength and processing time. The observations showed the superiority of friction welding to diffusion bonding.