This thesis deals with the various studies made on the newly developed titanium based biomedical alloys which are claimed to be superior compared to the conventional Ti-6Al-4V system, because of their low modulus and non-toxic alloying elements. The first chapter of the thesis deals with the introductory aspects of biomaterials, literature survey and the scope of the present work. Non-consumable vacuum arc technique was used to prepare the so-called second generation alloys Ti-13Nb-13Zr, Ti-20Nb-13Zr and Ti-20Nb-20Zr and the second chapter describes the experimental techniques such as the alloy preparation, thermomechanical processing, optical microscopy, X-ray diffraction, Electron probe micro analysis, potentiodynamic measurement and laser nitriding.

The work consists of determination of the β transus temperature, hot rolling and heat treatment of the new alloys at temperatures below and above their respective β transus. The effect of the alloying elements on the phase transformation was studied using optical microscope and X-ray diffraction analysis. Electron probe micro analysis was extensively utilized to quantitatively as well as qualitatively analyse the elements present in the various phases to interpret some of our new observations. The results of this work are discussed in chapter 3.

Laser nitriding was performed on all the three alloys using low power Nd YAG laser to study the effect of this treatment on the hardness variation and microstructural modification as a function of the concentration of the alloying elements. Chapter 4 describes in detail the results of the laser nitriding study.
Further, the variation in the corrosion behavior of the heat-treated and laser-nitried Ti-13Nb-13Zr alloy in simulated body fluid was investigated using Open circuit potential-time (OCP) measurement and Anodic cyclic polarization techniques. This work was undertaken to have an overall understanding on the influence of the alloying elements towards corrosion. The important observations of the corrosion study are presented in chapter 5.

A fine equiaxed structure was obtained on hot rolling and heat treating the alloy Ti-20Nb-13Zr in the $\alpha+\beta$ phase field. Moreover, laser nitriding on this alloy resulted in higher hardness without crack formation. The corrosion resistance of the laser nitried Ti-13Nb-13Zr alloy in simulated body solution was very high when compared to that of the untreated alloy. The importance of the present work especially in bringing out the role of the alloying elements on phase transformation is highlighted in the concluding section. In addition, other important observations made are summarized and critically analyzed in the last chapter.