SUMMARY

The present thesis has the aim of presentation and research of the manufacturing of hip joint implant and also tools for their construction, through precision and ultra precision manufacturing and specifically high speed machining. The thesis is devided in seven chapters, each one of them has a specific theoretical, experimental or numerical important part, based on above topic.

In the first chapter, it is examined the manufacturing with material removal, a basic and important aspect of the manufacturing process in industry. It emphasizes in precision and ultra precision manufacturing and particular, in high speed manufacturing. Additionally, it is presented the technology in all these processes, and everything that has to do with the better selection of cutting parameters and cutting tools. Finally, a number of models for the calculation of forces is presented, in turning and each of them can be used for the calculation of forces in high speed machining and also, the effectiveness of this process, based on the final surface's quality.

In the second chapter, there are presented the materials from which hip joint implants are manufactured, not only femoral heads but also stems, acetabular cups and acetabular implants. Generally, there is a division of materials in metallic, ceramic and polymeric, where their general mechanical and natural properties are presented. Finally, there is a presentation of all the problems and the failures that can be occurred in implants, thus of stresses acted on them and their wear during the walking of the patient.

The third chapter presents the way that the femoral heads are manufactured, not only for metallic, but also for ceramic ones, the cutting parameters that must be taken into consideration and also the factors that affect the process and play a tremendous role for its success, like cutting forces. Their manufacture took place in the CNC lathe of the laboratory, which can rotate each spindle up to 10000 rpm and move its axis with accuracy of 0.1μm. The cutting forces were measured during the process of manufacturing of metallic heads, and the results were compared to numerical results from calculating models, that have been presented in first chapter and also with the results of finite elements analysis.

In the fourth chapter it is presented the designing and manufacturing of a die for the construction of a stem. The materials that the stems are manufactured by are

titanium alloys, which are difficult to be machined with cutting processes and for this reason are manufactured with hot bulking. A bulking die, was manufactured in the field of the present Thesis in a CNC machining centre. Whereas, stems are parts with complex shape, special defined by the International Standards, which are consisted of a number of curves, they are considered as sculptured surfaces.

In the fifth chapter there are presented the methods of checking the accuracy of the implants. Generally, the implants are under strict standardization, according to the strict International Standards, not only from manufacturing aspect, but also from checking aspect. For the second aspect, it has to do with two things; the first is the accuracy of the dimensions and the surface quality of the construction and the second one is the resistance in static and dynamic load. The aim of this chapter is the investigation about the accuracy of the implants, which were constructed in the laboratory, metallic and ceramic, and also there will be exported some numerical models, which will predict the surface roughness, in reference to the cutting parameters. Furthermore, it will be presented the accuracy of the die construction as it plays a specific role in the manufacturing of the stem.

In the sixth chapter it is presented the testing of the resistance in static load of the femoral heads. The implants are checked not only for their accuracy in dimensions and surface roughness, but also for their resistance in loads, as they are distressed whiles the walking of the patient and consequently of the way of move the loads that act on them can reach twenty times the patient weight. For this reason, a number of tests, not only static but also dynamic, have been set down by the international standards. In this particular occasion they were used only the static tests, not only experimental, but also numerical, with the use of finite element software, for the better comparison of the results.

Finally, in the last chapter, the seventh, it is presented the final conclusions of the Thesis from the experimental and numerical investigation of the construction of implants and their examination, not only for their resistance but also for their accuracy.