# *Preface*

This thesis reports the preparation of some composites, characterization, and in-vitro properties investigations. The preparation of zirconia substituted 1393 bioactive glass involves stepwise hydrolysis and polycondensation of the precursors to prepare gel. To prepare the composites, reinforcing materials such as hydroxyapatite, and baghdadite were prepared by co-precipitation and solid-state method respectively. The in-vitro bioactivity, cytocompatibility, and mechanical performances of composites were measured. The in-vitro bioactivity was measured through structural (XRD), functional (FTIR) and morphological (SEM-EDX, EDS mapping) changes due to surface modification and behavioral changes (pH) of SBF (simulated body fluid) due to ion exchange. The in-vitro cytocompatibility of composites was analyzed on MG 63 cell line (Human osteosarcoma fibroblast cell) to assess the viability, proliferation, and apoptosis of cells on the composites. Hemocompatibility was also measured on the composites. Mechanical properties of the composites along with the parent material were examined using UTM by measuring the compression strength. Physical properties such as density were also analyzed by Archimedes' principle. The biocompatibility and physicomechanical properties of the composites were enhanced as compared to the parent material. This thesis is divided into 8 Chapters.

**Chapter 1** is the introduction of the thesis work which includes the background related to biomaterials, composites, and the objective of the research work. It describes the concept of biomaterials, their history, application, and also provides the concept of composites in biological applications.

**Chapter 2** includes the literature review of the biomaterials associated with this thesis. This chapter includes a brief discussion related to associate biomaterials, their synthesis processes, properties, and drawbacks.

**Chapter 3** describes the materials used, the synthesis process of bioactive glass, reinforcing materials, and composites. The characterization techniques and their principles are described in detail. Furthermore, the standard protocols and procedures to evaluate the in-vitro bioactivity, hemolytic behavior, cellular response, and mechanical property of the synthesized materials and composites are described.

**Chapter 4** describes the influence of the addition of hydroxyapatite in the zirconia substituted 1393 bioactive glass system. The effect of increasing sintering temperature on bioactivity, compressive strength, and proliferation was studied in detail. In brief, starting from the raw materials selection, optimization of the synthesis process, composite preparation, and the in-vitro bioactivity by XRD, FTIR, SEM, pH, and in-vitro cell culture in terms of proliferation are elaborated in this section. All obtained results were compared with sintering temperature.

**Chapter 5** reports the effect of zinc oxide in the baghdadite ceramic system. In this section, hemolytic behavior, cell staining, antibacterial behavior, and compressive strength of composites are studied. The in-vitro bioactivity behavior of composite materials was studied by using XRD, FTIR, and SEM after immersing in the SBF.

**Chapter 6** presents the effect of Zinc oxide in the zirconia substituted 1393 bioactive glass system. This composite system describes the effect of zinc oxide addition on mechanical as well as bioactivity and biocompatibility properties.

**Chapter 7** studies the effect of baghdadite in the zirconia substituted 1393 bioactive glass composite system. In this section, the bioactivity, and pH behavior of composites are studied.

**Chapter 8** describes the conclusion of the entire work. The future scope is also included in this chapter which is the proposal based on the results and explanation obtained in this thesis work.