Nowadays, medicine has been facing new challenges that are ultimately related to improve quality of human life. The major challenges include the treatment of large tissue defects resulting from tumors, trauma and infections, which can not be dealt without any assistance. In such cases, regenerative medicine and tissue engineering are applicable. The tissue engineering, by the use of biocompatible, porous materials with tailored spatial forms, aims to create appropriate conditions for tissues regeneration. Moreover, to support the regeneration process, some components are added to scaffolds, tailored to the type of regenerated tissue, so that resulting composite materials can better serve their applications, improving the regeneration process. **The presented study mainly aims to obtain a multifunctional gel-derived complex bioglasses doped with ions of elements that usually play a role of micronutrients and trace elements in the human body (strontium (Sr), zinc (Zn) and cerium (Ce)) so that they could possibly have the ability to support regeneration of both bone and cartilage tissue and exhibit antioxidant and antibacterial properties, and thus be promising in the tissue engineering applications of different types of tissues. Moreover, the project is intend to determine: the correlation between a type and concentration of the modifiers (Sr, Zn, Ce), introduced to the glass systems individually and in selected compositions, and their material properties (structural, microstructural and chemical) and the bioactive performance. The third goal of the project is conducting a selected materials preliminary *in vitro* biological evaluation on two cell lines, osteoblasts and chondrocytes and select materials with modifiers combinations possibly exhibiting osteogenic, chondrogenic and antioxidant and antibacterial effects**. Research methodology we plan to use during the Project will include: **(i)** designing the simple bioglasses compositions and fabrication them with the sol-gel route; **(ii)** determination of structural, microstructural and chemical properties of simple bioglasses as well as their bioactive properties and ions dissolution in the SBF solution; **(iii)** selection of most suitable modifiers concentrations based on the experimental results; **(iv)** designing the complex bioglasses compositions and selecting their manufacturing process parameters, fabrication of complex bioglasses with the sol-gel route; **(v)** determination of structural, microstructural and chemical properties of complex bioglasses along with their bioactive properties and ionic dissolution in SBF, examining complex bioglasses antioxidant properties; **(vi)** fabrication of the model composite polymer-ceramics materials, containing selected complex bioglasses, for the *in vitro* biological and antibacterial properties experiments purposes; **(vii)** Preliminary in vitro biological studies on the osteoblasts (NHOst) and chondrocytes (NHAC) in the direct contact with materials, examination cells morphologies, proliferation and markers representative for particular cell lines (NHOst - ALP activity, collagen type I level, ECM mineralization level; NHAC - collagen type II level, aggrecan level); **(viii)** Antibacterial properties determination on the selected materials. At the final stage we will select materials that possibly support bone tissue and cartilage tissue formation and exhibit promising antioxidant and antibacterial properties. Analyses we intend to proceed during the project are intend to give a extensive information about the multi-component doped with Sr, Zn and Ce gel-derived bioglasses properties. We believe that studies in this project will provide essential knowledge in the field of materials science, especially in the branch connected with bioactive materials science as well as in bioglass science. We expect that results of our studies will contribute to the development of the sciences like regenerative medicine and tissue engineering.