As discussed earlier in Chapter 1, the demand of orthopedic implants are growing rapidly due to the increase in the diseases like osteoporosis (weakening of bone) and osteoarthritis (inflammation in the bone joints), the research in the field of development of reliable bone implants are also increasing. In the introduction and literature survey section we have studied that by incorporating pores inside the bulk of metallic based implant; its elastic modulus can be reduced due to which the problem of stress shielding effect associated with conventional metallic implant can be reduced significantly. Different techniques employed for the development of porous metallic implant are also discussed.

Considering the advantages of developing porous metallic implant material, the main objective of the presented research work is to develop low cost metallic and ceramic based composite by effective utilization of Rice Husk (RH) waste for multiple applications. Initially, RH was used as a space holder material to create pores inside the metallic and ceramic matrix along with this RH also acts as a source of Silica (SiO_2) which helps in increasing the strength of the porous metallic and ceramic based scaffold.

The main objectives of the present work are as follows:

1. **Selection of potential waste materials**

   As discussed above the main motive of the present research work is to develop cost effective implant material potentially utilized for biomedical implant application. Considering this the raw material used in the research are agricultural waste (RH) and animal bones waste (ABW).

2. **Synthesis of different metallic and ceramic based composites**

   Initially, the presented research work is divided into two different experiments. The first experiment is an approach to develop Titanium (Ti) based porous composite by utilizing RH as a space holder material and source of silica as well. Different size and wt% of RH was mixed in Ti matrix in order to prepare green compacts. The green compacts undergoes through two stage sintering process to produce Ti-SiO_2 composite scaffold. In another experiment Silica dopped Tricalcium Phosphate scaffold was fabricated by effective utilization ABW and RH. ABW was used as a source of hydroxyapatite (HAp) and RH was used as a space holder material and source of SiO_2. Different Wt% of RH is mixed in HAp matrix in order to fabricate green HAp-SiO2 composite. These green samples were sintered at different temperatures to develop silica dopped tricalcium phosphate scaffold.

3. **Advanced physical and structural characterization**

   - To measure apparent porosity of sintered samples to determine their densification behaviour.
   - To characterize different elemental compositions, present in the samples.
   - To identify the phase formed in the samples, they were characterized by using X-Ray Diffractometer (XRD).
   - To determine microstructural and surface morphology of the porous samples with the help of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM).

4. **Mechanical characterizations**

   - To study the failure behaviour of developed composite scaffold under Compression.

- To determine the elastic modulus of the developed porous scaffold and to compare its value with that of rigid samples.

5. Biological characterization

- To study the ability of developed porous scaffold to form apatite layer on its surface bioactivity test was performed by immersing the samples in simulated body fluid (SBF) for different time periods.
- To evaluate the ability of scaffold to form biofilm throughout their surface Staphylococcus aureus (S. aureus) strain (ATCC 29213) was used for biofilm formation.
- Cell toxicity analysis of the specimens by using MC3T3-E1 cell line sub-clone 4 (ATCC).