Dedicated to the almighty above, to my father, Late Shri Akhilesh Chandra Bharti, who unfortunately didn't stay in this world long enough to see his son become a doctor, to my mother Usha Rani and my wife, Priyanka, who didn't let me lose my calm and composure.

CERTIFICATE

This is to certify that the work contained in the thesis entitled: "**SYNTHESIS AND CHARACTERIZATION OF Ti BASED METAL CERAMIC MATRIX COMPOSITES FOR BIOIMPLANT" by VIPUL SAXENA** has been carried out under supervision Prof. Vinay Kumar Singh and this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Course work, Comprehensive Examination, SOTA and Pre-Ph.D. seminar for the award of Ph.D. Degree.

Supervisor's Signature
Prof. Vinay Kumar Singh
Department of Ceramic Engineering
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Varanasi-221005

ANNEXURE-E

CANDIDATE'S DECLARATION

I, **Mr. Vipul Saxena**, certify that the work embodied in this Ph.D. thesis is my own bonafide work carried out by me under Prof. Vinay Kumar Singh **Department of Ceramic Engineering from December 2013 to December 2019 at Department of Ceramic Engineering, Indian Institute of Technology (Banaras Hindu University), Varanasi.** The matter embodied in this Ph.D. thesis has not been submitted for the award of any other degree/diploma.

I declare that I have faithfully acknowledged, given credit to and referred to the research workers wherever their works have been cited in the text and the body of the thesis. If further certify that I have not willfully lifted up some other's work, para, text, data, results, etc. reported in the journals, books, magazines, reports, dissertations, theses, etc. or available at websites and included them in this Ph.D. thesis and cited as my own work.

Date:29 Dec 2021

Place: IIT (BHU), Varanasi **Vipul Saxena**

Certificate from the Supervisor and Head of the Department

This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

Supervisor's Signature
Prof. Vinay Kumar Singh
Department of Ceramic Engineering

Signature
(Head of the Department)
(With Seal)

ANNEXURE-G

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Date: 29/12/2021

Place: Varanasi **(Vipul Saxena)**

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ABBREVIATIONS ANDSYMBOLS

%–Percentage

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°C – Degree centigrade

α-Alpha

β-Beta

γ-Gama

Θ- Theta

Δ-Delta

μm-Micrometer

mm–Millimeter

nm-Nanometer

cm– Centimeter

Kg–Kilogram

gm –Gram(s)

m–Molar

min–Minutes

sec–Second

h–Hour

ev-Electron Volts

A^0 -Augustan

ρ -Density

XRD–X-ray diffraction SEM–Scanning electron microscopy EDS–Energy dispersive X-ray spectroscopy

TEM- Transmission Electron Microscopy

HR-TEM–High Resolution Transmission Electron Microscopy

FTIR- Fourier-transform infrared Spectroscopy

PREFACE

The basis for this research work originally comes from my passion for developing nearly mimic implant so that needy peoples may be benefited. As the world moves further into the faster life, the chances of accidents and health issues are very frequent .To meet out the recovery, our society should have right matched replacement of our bones and more organs and bio functional entities. Keeping this as motivation, firstly I have gone into quest that what are the current problems running with the bio implants especially in load bearing bone implants where metallic implant are currently used . By going through lot of literatures, I came to know certain drawbacks and limitation of currently used metallic implants which I have made my basis for research and here in my thesis, to best of my capabilities, I have tried to find out the solution of current drawbacks.

It has been found that currently Ti-6Al-4V alloy is being used in orthopedic implant due to its comparable greater compressive and tensile strength, yield strength, and high resistance to corrosion in biological environments. Although these have all greatly improved the quality of life with their introduction, but they still suffering from some drawback like high Young's modulus (110 GPa) as compared to cortical bones (5 GPa) and with the long term use, Al and V may cause allergic reaction and neurological disorders like Alzheimer's disease (14).High cost is also one of the constraint for economical point of view.

The current thesis deals with the study of titanium based various metal ceramic composite which may be potentially used for the load bearing bio implants. In this work, titanium and their alloys matrix are reinforced with the selective bioactive ceramics.

The entire thesis is divided into seven different chapters and the references are given at the end of each chapter.

Chapter 1 comprises of general introduction about primarily used elements like titanium and biomaterials .The brief summary of these element is discussed along with current problems and objectives.

Chapter 2 gives the brief about the literature of other researchers, their findings and some important properties of titanium with their application as bio implant .The challenges and remedies of metal bio-implants are also discussed.

Chapter 3, the detail of materials used, experimental setup, synthesis method testing and characterization techniques are discussed which have been employed to perform the works presented in the thesis,

Chapter 4 describe the effect of reinforcing 1393B3 bioactive glass on the physical, mechanical, biological and corrosion properties of the biomedical composite in the matrix of alloy Ti-Si –Mn was investigated.

Chapter 5 reported the attempt to find out the reinforced effect of S53P4 bioactive silicate glass in TI-Nb-Fe alloy matrix on the biomechanical, corrosion properties of composite.

Chapter 6 deals with the different alloy matrix of ti i.e Ti-Mo-Fe and reinforcing the S53P4 bioactive glass in the that matrix to observe the structural ,biological ,corrosion and mechanical behavior of composite.

Chapter 7 is the concluding chapter in which I have summarized the result obtain to reach on some conclusion