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I, **Usha Rani**, declare that the thesis entitled “**Bioprocess development for the biological removal of iron from subsurface drinking water in Uttarakhand**” is my own work conducted under the supervision of Dr. Sanjay Gupta and Dr. Vivek Kumar at **Himalayan School of Biosciences**, Swami Rama Himalayan University, approved by D.R.C.

I further declare that to the best of my knowledge the thesis does not contain any part of any work which has been submitted for the award of any degree either in this University or in any other University/ Deemed University without proper citation.

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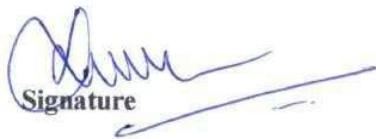
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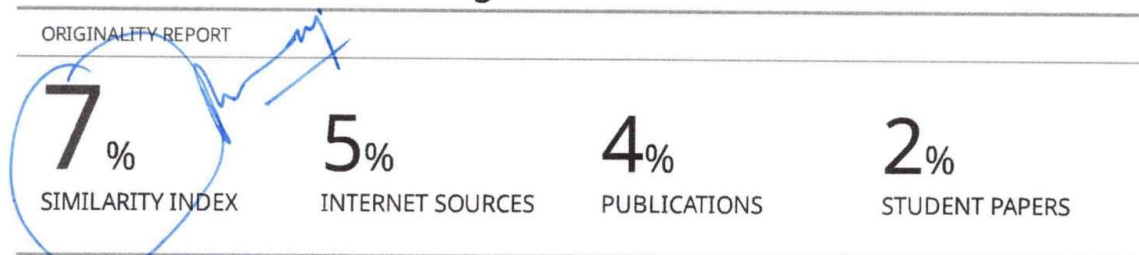
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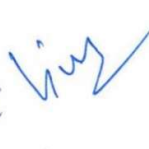

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**"BIOPROCESS DEVELOPMENT FOR THE
BIOLOGICAL REMOVAL OF IRON FROM
SUBSURFACE DRINKING WATER IN
UTTARAKHAND"**

Submitted by

Usha Rani

For the degree of

Doctor of Philosophy in the faculty of

Biotechnology

is evaluated and approved by

CO-SUPERVISOR

SUPERVISOR

EXAMINER

Undertaking for submission of Ph. D. thesis

I solemnly declare that research work presented in the thesis titled "**Bioprocess development for the biological removal of iron from sub-surface drinking water in Uttarakhand**".

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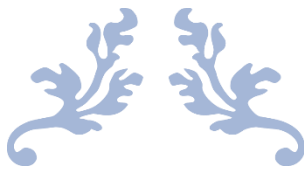
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Dedicated to my parents

For their eternal Love, support and
encouragement



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LIST OF ABBREVIATIONS

S. No.	Abbreviation	Full form
1.	AAS	Atomic absorption spectrophotometry
2.	Al ³	Aluminum Cation - typically represented as Al ³⁺ or simply Al when referring to the element.
3.	ANOVA	Analysis of variance
4.	Ar	Argon
5.	BIS	Bureau of Indian Standards
6.	C	Celsius
7.	CaCO ₃	Calcium carbonate
8.	Cl	Chlorine
9.	ClO ₂	Chlorine dioxide
10.	CO ₂	Carbon dioxide
11.	E	East
12.	EPA	Environmental Protection Agency
13.	Fe	Iron
14.	Fe ⁺²	Ferrous ion
15.	Fe ⁺³	Ferric ion
16.	FeCO ₃	Iron (II) carbonate
17.	FeOOH	Iron (III) hydroxide
18.	FeSO ₄	Ferrous sulfate
19.	FeSO ₄ .7H ₂ O	Iron (II) sulfate heptahydrate

20.	gm	Gram
21.	H ₂ O ₂	Hydrogen peroxide
22.	H ₂ SO ₄	Sulfuric acid
23.	HCL	Hydrochloric acid
24.	IOB	Iron-oxidizing bacteria
25.	KH ₂ PO ₄	Potassium dihydrogen phosphate
26.	KHC ₈ H ₄ O ₄	Potassium hydrogen tartrate
27.	KHC ₈ H ₄ O ₄	Potassium hydrogen phthalate
28.	KMnO ₄	Potassium permanganate
29.	L	Liter
30.	Mn ²⁺	Manganese
31.	M	Meter
32.	m/h	Meters per hour
33.	ml/L	Milligrams per liter
34.	mm	Millimeter
35.	mmol/L	Millimoles per liter
36.	Mn	Manganese
37.	Mn+2	Manganous oxide
38.	Mn+4	Manganese oxide
39.	MnCl ₂	Manganese (II) chloride
40.	MgSO ₄	Magnesium sulfate
41.	MPN	Most probable number

42.	N	North
43.	NITREDOX	A method for nitrate removal
44.	(NH ₄) ₂ SO ₄	Ammonium sulfate
45.	O	Oxygen
46.	O ₃	Ozone
47.	P value	Probability value
48.	pH	Potential of hydrogen
49.	ppm	Parts per million
50.	RPM	Revolutions per minute
51.	SiO ₂	Silicon dioxide
52.	SO ₄	Sulfate
53.	SPSS	Statistical package for the social sciences
54.	THMs	Trihalomethanes
55.	TOC	Total organic carbon
56.	UV	Ultraviolet
57.	WHO	World health organization
58.	X	Magnification