

**NATURAL RADIOACTIVITY STUDIES IN THE ENVIRONS OF  
NORTHERN RAJASTHAN**

**A  
THESIS  
SUBMITTED TO**



**MAHARAJA RANJIT SINGH  
PUNJAB TECHNICAL UNIVERSITY  
BATHINDA, PUNJAB (INDIA)**

**IN FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF**

**DOCTOR OF PHILOSOPHY  
IN  
FACULTY OF SCIENCES**

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(2022)**

## **CANDIDATE'S DECLARATION**

---

I hereby declare that the work which is being presented in the thesis, entitled **“NATURAL RADIOACTIVITY STUDIES IN THE ENVIRONS OF NORTHERN RAJASTHAN”** in fulfilment of the requirements of the award of the degree of Doctor of Philosophy in Faculty of Sciences and submitted in Department of Physics, Maharaja Ranjit Singh Punjab Technical University, Bathinda, is an authentic record of my own work carried out during a period from November 2016 to June 2022 under the supervision of Dr. Sandeep Kansal, Professor & Head, Department of Physics, MRSPTU, Bathinda and Dr. Rohit Mehra (Co-supervisor), Associate Professor, Dr. BR Ambedkar National Institute of Technology, Jalandhar.

The matter embodied in this thesis has not been submitted by me for the award of any other degree of this or any other University/Institute.

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

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# **DEDICATION**

**MY DEGREE IS DEDICATED TO**

**MY LOVING PARENTS**

**AND**

**MY WIFE**

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## **PREFACE**

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The present research work has been carried out to study the natural radioactivity for the radiological risk assessment in the water, air and soil in the three districts of Northern Rajasthan. The complete work and the findings have been compiled into thesis and has been divided into following five chapters:

### **CHAPTER 1: INTRODUCTION**

This chapter covers the history of radiation and radioactivity, radiation related parameters like exposure, sources, protection, radioactive elements of concern in the present study and related literature as well as information about the geology of the study area and the objectives.

### **CHAPTER 2: INSTRUMENTS, MATERIALS AND TECHNIQUES**

This chapter deals with the details, working and principle of instruments, materials used during research work like single entry pinhole dosimeter, deposition based direct progeny sensors (DRPS/DTPS), wiremesh type DRPS/DTPS, LR-115 type-II films, constant temperature etch bath, spark counter and scintillation based Smart RnDuo.

### **CHAPTER 3: RADON/THORON, THEIR PROGENY CONCENTRATION AND ATTACHED/UNATTACHED FRACTIONS IN INDOOR AIR**

This chapter describes the brief introduction about topic, methodology and measurement of indoor radon/thoron gas, their progeny concentration and attached/unattached fractions. The standard formulae have been used to calculate the annual effective dose and associated health risk assessment for the residents of the studied area. At the end, results and conclusion has been discussed.

### **CHAPTER 4: QUANTIFICATION OF RADON IN WATER**

This chapter deals with the introduction and literature related to radon in water, detailed methodology and measurement of activity concentration of radon in water. Standard formulae have been used to calculate inhalation and ingestion dose received from radon in water. The detailed results and conclusion have been incorporated.

## **CHAPTER 5: RADON/THORON EXHALATION RATES IN SOI SAMPLES AND THEIR CORRELATION WITH INDOOR CONCENTRATION**

This chapter deals with the introduction about topic, methodology and formulae used for measurement of radon/thoron exhalation rate in soil samples and their correlation with radon/thoron in the indoor air in the studied region. The results has also been compared with similar investigations in different geographical areas.

Finally, conclusion and scope of future work has been discussed.