

**RADIOLOGICAL RISK ASSESSMENT IN THE ENVIRONS OF
MOGA AND BARNALA DISTRICTS OF PUNJAB**

**A
THESIS
SUBMITTED TO**



**MAHARAJA RANJIT SINGH
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**IN FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF**

**DOCTOR OF PHILOSOPHY
IN
FACULTY OF SCIENCES**

**By
Supriya Rani
(Registration No.–18406FPE01)
Department of Physics
Maharaja Ranjit Singh Punjab Technical University
Bathinda, Punjab, India
(AUGUST 2022)**

CANDIDATE'S DECLARATION

I hereby declare that the work which is being presented in the thesis, entitled **“RADIOLOGICAL RISK ASSESSMENT IN THE ENVIRONS OF MOGA AND BARNALA DISRICTS OF PUNJAB”** 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 July 2018 to August 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.

(Supriya Rani)

Registration No. 18406FPE01

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

(Dr. Sandeep Kansal)

(Supervisor)

Department of Physics

MRSPTU, Bathinda

(Dr. Rohit Mehra)

(Co-Supervisor)

Department of Physics

Dr. BR Ambedkar NIT, Jalandhar

The Ph.D Viva-Voice examination of **Supriya Rani (18406FPE01)** Research Scholar, has been held on _____.

Sign of Supervisor

Sign of Co-Supervisor

Sign of External Examiner

DEDICATION

MY DEGREE OF DOCTOR OF
PHILOSOPHY IS DEDICATED TO
MY HUSBAND

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LIST OF FIGURES

Figure No.	Title	Page No.
1.1	Ionizing and non-ionizing radiations	3
1.2	Penetrating power of ionizing radiations	6
1.3	Sources of distribution of all radiation dose	6
1.4	Annual effective dose per person in United States (2007)	8
1.5	Deterministic and stochastic health effects	11
1.6	Uranium decay series	15
1.7	Thorium decay series	16
1.8	Various sources of uranium in groundwater	18
1.9	Pathways of uranium exposure	20
1.10	Compartmental model of uranium with hair excretion pathway	23
1.11	Entry routes of radon and thoron in dwellings	26
1.12	Release mechanism of radon into atmosphere	27
1.13	Map of studied area (Barnala and Moga districts of Punjab)	30
2.1	Single entry pinhole dosimeter	34
2.2	Deposition based radon/thoron progeny sensors (DRPS/DTPS)	37
2.3	The structural formula of cellulose nitrate (LR-115) plastic track detector	38
2.4	Tracks formed in polymers caused by the passage of heavily charged particles	39
2.5	Constant temperature bath unit	41
2.6	Spark counter	42
2.7	Circuit diagram of spark counter	43
2.8	Schematic diagram of Smart RnDuo a portable monitor	44
2.9	Set up for measurement of radon mass exhalation rates using Smart RnDuo (diffusion mode)	46
2.10	Set up for measurement of thoron surface exhalation rates using Smart RnDuo (flow mode)	47
2.11	A setup for measurement of radon concentration in water samples	47
2.12	LED Fluorimeter along with accessories	49
2.13	a) pH meter b) TDS/EC meter	50

Figure No.	Title	Page No.
3.1	Preparation of dosimeters	54
3.2	Dosimeters suspended from the roof of building	55
3.3	Seasonal variation of a) radon and b) thoron concentration in the dwellings	60
3.4	Seasonal variation of a) radon progeny concentration (EERC) and b) thoron progeny concentration (EETC) in the dwellings	61
3.5	Frequency distribution of radon concentration (C_r) in Barnala district	63
3.6	Frequency distribution of thoron concentration (C_t) in Barnala district	63
3.7	Frequency distribution of radon progeny concentration (EERC) in Barnala district	64
3.8	Frequency distribution of thoron progeny concentration (EETC) in Barnala district	64
3.9	Frequency distribution of radon concentration (C_r) in Moga district	65
3.10	Frequency distribution of thoron concentration (C_t) in Moga district	65
3.11	Frequency distribution of radon progeny concentration (EERC) in Moga district	66
3.12	Frequency distribution of thoron progeny concentration (EETC) in Moga district	66
3.13	Correlation between a) Radon concentration (C_r) and EERC and b) thoron concentration (C_t) and EETC in Barnala district	67
3.14	Correlation between a) Radon concentration (C_r) and EERC and b) thoron concentration (C_t) and EETC in Moga district	68
3.15	Box-whisker plot for radon concentration (C_r) and EERC in Barnala district	69
3.16	Box-whisker plot for radon concentration (C_t) and EETC in Barnala district	69
3.17	Box-whisker plot for radon concentration (C_r) and EERC in Moga district	70

Figure No.	Title	Page No.
3.18	Box-whisker plot for thoron concentration (C_t) and EETC in Moga district	70
3.19	Box-whisker plot for total annual inhalation dose in Barnala district	71
3.20	Box-whisker plot for total annual inhalation dose in Moga district	72
4.1	Process of release of radon gas to atmosphere from the soil	98
4.2	Frequency distribution of radon mass exhalation rates in studied area	103
4.3	Frequency distribution of thoron surface exhalation rates in studied area	104
4.4	Correlation of radon mass exhalation rates with radon concentration in the dwellings of Barnala district	104
4.5	Correlation of thoron surface rates with thoron concentration in the dwellings of Barnala district	105
4.6	Correlation of radon mass exhalation rates with radon concentration in the dwellings of Moga district	105
4.7	Correlation of thoron surface rates with thoron concentration in the dwellings of Moga district	106
5.1	A Systematic presentation of water sample collection from source	118
5.2	Set-up for measurement of radon in liquid sample	119
5.3	Frequency distribution of radon concentration in Barnala district	122
5.4	Frequency distribution of radon concentration in Moga district	123
5.5	Correlation of radon concentration in underground water with depth (in meters) in studied area	123
5.6	Inter comparison for radon concentration between surface water and underground water in studied area	125
5.7	Comparison between radon concentration in water samples collected from different sources of underground water sources in studied area	125
6.1	Measurement of uranium concentration in water samples using LED Fluorimeter	145

Figure No.	Title	Page No.
6.2	Frequency distribution of uranium concentration in Barnala district	150
6.3	Frequency distribution of uranium concentration in Moga district	151
6.4	Correlation of uranium concentration in underground water with depth (in meters) in studied area	151
6.5	Comparison between uranium concentration in underground water taken from different depths in Barnala district	152
6.6	Comparison between uranium concentration in underground water taken from different depths in Moga district	153
6.7	Dose percentage to various organs using biokinetic model in Barnala district	159
6.8	Dose percentage to various organs using biokinetic model in Moga district	159
6.9	Frequency distribution of pH value a) underground water b) surface water	161
6.10	Frequency distribution of total dissolved solids (TDS) a) surface water b) underground water	162
6.11	Frequency distribution of electrical conductivity (EC) a) underground water b) surface water	163
6.12	Correlation of uranium concentration with pH in water in a) Barnala district b) Moga district	164
6.13	Correlation of uranium concentration with total dissolved solids (TDS) in water in a) Barnala district b) Moga district	165
6.14	Correlation of uranium concentration with electrical conductivity (EC) in water in a) Barnala district b) Moga district	166

LIST OF TABLES

Table No.	Title	Page No.
3.1	Statistical analysis of Seasonal variation of radon, thoron, and their progeny (EERC/EETC) concentration using passive technique	74
3.2	Annual average radon/thoron and their progeny concentration and total annual effective inhalation dose using passive technique	76
3.3	Radon/thoron gas concentration in the dwellings using active technique	89
3.4	Comparison of radon/thoron and their progeny with the similar investigation in other states of India	96
4.1	Radon/thoron exhalation rates in the soil samples	108
4.2	Average indoor radon/thoron concentration in dwellings and radon/thoron exhalation rates in the soil samples	111
4.3	Comparison of radon mass/thoron surface exhalation rates with other similar investigations in India	114
5.1	Radon concentration and Annual effective dose due to ingestion and inhalation for various age groups in Barnala district	127
5.2	Radon concentration and Annual effective dose due to ingestion and inhalation for various age groups in Moga district	134
5.3	Radon concentration in water samples of different sources of water in studied area	139
5.4	Worldwide comparison of radon concentration in water samples	140
6.1	Uranium concentration, cancer morbidity, mortality, lifetime daily average dose, hazard quotient in studied area	168
6.2	Annual effective ingestion dose due to uranium concentration in water in various age groups of studied area	183
6.3	Literature survey of uranium distribution in groundwater samples of different regions of India	185
6.4	Biokinetic data of ingested uranium through drinking water	187
6.5	Dose received to various organs using biokinetic modelling	196
6.6	Measurement of pH, TDS and EC in Studied Area	197

PREFACE

For the radiological risk assessment in the environs of Moga and Barnala districts of Punjab. The study has been carried out in air, water and soil for radon/thoron, their progeny and uranium concentration by using various active and passive techniques. The data has been compiled and the results are presented here. The thesis has been divided into the following six chapters:

CHAPTER 1: INTRODUCTION

This chapter deals with the introduction and literature review regarding the history of radioactivity, radiations and its types and hazardous effects of ionizing radiations. Brief description of concepts like as radiation exposure, sources of radiations, dose, units and protection are included in this chapter. The standard values are set for dose limits for radiations by various governmental/non-governmental and national/international bodies such as WHO, ICRP, UNSCEAR, USEPA, IAEA and AERB are reported in this chapter. A detailed literature review dealing with natural radiations has been discussed and the geology of the studied area and finally the objectives of the present study are reported in this chapter.

CHAPTER 2: MATERIALS, INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES

This chapter deals with the various materials, instruments and experimental techniques used in the present study to assess the radiological risk in the environs of the study area. Both short term (active) as well as long term (passive) techniques have been used in the present experimental measurements.

CHAPTER 3: RADON/THORON AND THEIR PROGENY CONCENTRATION IN THE DWELLINGS

This chapter deals with the measurement of radon, thoron and their progeny concentration in the indoor environment of Barnala and Moga districts for the residents of Punjab, India. The study has been carried out throughout the year for seasonal variation using grid pattern for mapping of the whole area with time integrated passive technique using single entry pinhole dosimeters and deposition-based radon/thoron progeny sensors (DRPS/DTPS). The annual average radon/thoron and their progeny

concentration, annual effective dose and equilibrium factor in various types of dwellings has been calculated.

CHAPTER 4:RADON/THORON EXHALATION RATES IN SOIL AND ITS CORRELATION WITH THEIR CONCENTRATION IN THE DWELLINGS

This chapter deals with the measurement of radon/thoron exhalation rates in the soil samples collected from the studied area. A scintillation-based detector, Smart RnDuo has been employed for the measurement. And also, to find their correlation with indoor radon/thoron concentration levels.

CHAPTER 5: RADON CONCENTRATION IN WATER AND DOSE ESTIMATION

This chapter deals with the measurement of radon concentration in groundwater samples using Smart RnDuo. The water samples were collected from manually operated hand-pumps of privately owned or from hand-pumps established by Municipal Corporation in residential localities of studied area. The annual effective doses for ingestion and inhalation have been calculated.

CHAPTER 6:URANIUM CONCENTRATION IN WATER AND BIOKINETIC MODELLING

This chapter deals with the measurement of uranium concentration in water samples collected from different sources of water as underground and canal water. LED Fluorimeter has been used to measure the uranium concentration in water samples and also, mortality and morbidity risk have been calculated from the values of uranium concentration water to estimate the health risk to the residents of the studied area.