
A GIAN course on

◆ Advanced Direct Reading Radon, Thoron and Progeny Sensors

April 22-27, 2019

**Center for Advanced Research in Environmental Radioactivity (CARER),
Mangalore University, Mangalagangothri-574199, India**

Brochure link: www.mangaloreuniversity.ac.in/carere

Overview

Japanese scientists have developed many direct reading dosimeters for the radon, thoron and progeny measurements. These devices are mainly based on semi conductor detectors and such as other devices and dosimeters have significant advantages over conventional measurement techniques. Prof. Shinji Tokonami is one of the top scientists in the world in radon and thoron dosimetry. At National Institute of Radiological Sciences (now at Hirosaki, University), Japan the group lead by him had developed multiple measurement techniques and equipment related to the field. In particular, a special algorithm developed by him for determining airborne radon decay products with continuous air sampling and established a passive measurement technique for determining two radon isotopes (radon-222 & radon-220) separately. Based on this measurement technique, the ISO 16641 has been issued as one of international standards.

Prof. Y S Mayya has worked in Bhabha Atomic Research Center (BARC), Mumbai for nearly 35 years and he has been responsible for developing Direct Radon & Thoron Progeny sensors, nick named as DRPS & DTSP - first passive devices in the world for cumulating progeny concentrations. These devices have been deployed for thoron doses vis-a-vis radon doses & equilibrium factor assessment across Europe and India –and have provided excellent results. He has also developed active measuring devices – Rn Tn DUO for continuous monitoring of both radon and thoron. These developments have now been recognized worldwide as accurate measuring devices. He has also developed several

theoretical formulations for radon and thoron dosimeters which are used extensively by radon-thoron community worldwide. He catalyzed major collaborative R&D programmes across the country, including Mangalore University, which has resulted in major scientific and


technological developments. The work and publications of Prof. Shinji Tokanami and Prof. Y S Mayya have drawn the attention of the scientific community in the world. The Center for

Advanced Research in Environmental Radioactivity (CARER) is the leading research centre in India for studies on radiation protection, environmental radioactivity and radon/thoron dosimetry and calibration. Also, the CARER with its state of the art radiation measuring instrument is functioning as a national facility and researchers from many Universities and institutions are using the facilities at CARER.

The GIAN programme would bring together the two renowned scientists of the world in radon and thoron research to deliver lectures on the latest developments of the field. This one week course would provide a unique opportunity for the scientist working on radon and thoron dosimetry in India to interact with the two world-wide renowned scientists and gain knowledge on latest development in direct reading radon and thoron sensors. This course would lead to enhance bilateral collaboration between Indian scientists and Japanese counter parts for development of science, in general, and the research programmes of CARER, in particular.

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| <p><i>Dates</i> <i>April 22-27, 2019</i></p> <p style="text-align: center;"><i>Number of participants for the course will be limited to 50</i></p> | |
| <i>Who can attend</i> | Ph. D students, Post Graduate Students, faculty from Universities and research institutions, scientists from R&D laboratories such as, BARC, IGCAR, GSI, etc., and technical staff from industries. |
| <i>Fees</i> | <p>The participation fee (including taxes) for taking the course for different categories is as follows:</p> <p>Foreign participants : US \$ 350</p> <p>Industry/ Research Organizations : Rs. 10,000</p> <p>Academic Institutions/ Faculty/ NGO : Rs 5,000</p> <p>Research Scholars : Rs 2,000</p> <p>Students : Rs. 1,000</p> <p>The above fee includes all instructional materials, computer usage, internet facility, lunch and tea during session breaks. Participants will be provided accommodation on payment basis subject to availability.</p> |

The Faculty

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| <p>Dr. Shinji Tokonami, Professor Institute of Radiation Emergency Medicine Hirosaki University at Japan, will be the primary lecturer. He has 25 years of experience in this field and have published more than 14 books, 218 research articles, and 7 review articles in national as well as international journals. He is internationally recognised as a specialist in the field of Radon, Thoron and its progeny measurements. He developed a special algorithm for determining airborne</p> |  | <p>compact thoron calibration chamber and thereafter many thoron detectors developed in many countries were tested. After the Fukushima nuclear accident, he is currently working on a quick and effective technique to measure radioactivity in the thyroid to determine the dose and quantify the radiological impact due to a nuclear accident. Subsequently a new method has been developed for evaluating thyroid dose due to radioiodine with radiocesium in the body.</p> |
| <p>Dr. Y S Mayya is an adjunct professor in the Department of Chemical Engineering at the IIT-Bombay and at CARER, Mangalore University. He has co-authored 156 refereed Journal papers, two books and several conference papers on wide ranging topics in the fields of Aerosols, Radon and Radiation Physics. He has mentored many young</p> |  | <p>aerosol modeling, experimentation and instrumentation. He received the K.G. Vohra Memorial award from the Indian Association for Radiation Protection, and was nominated as an Aerosol Pioneer during the International Aerosol Conference (2018) organized by the American Association for Aerosol Research</p> |
| <p>Dr. Karunakara Naregundi, Professor & Coordinator at the CARER, Mangalore University. He has so far published 78 papers in national and international journals. He has 25 years of experience in wide ranging topics in the fields of radioecology and radiation protection, development of</p> |  | <p>new measurement techniques and instruments for the Radon and Thoron measurements and mitigation. He is a recipient of Sir C V Raman Young Scientist Award from Govt. of Karnata and Dr. A K Ganguly Award by the Indian Association for Radiation Protection (IARP)</p> |

Detailed Course Outline

| Day 1 | | |
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| Ssession, faculty, duration | Title of lecture | Brief contents lectures & expected skills to be developed from laboratory session |
| Lecture Session 1 | Introduction to the subject ST 1 hr | Physics of radon, thoron and progeny, Origin, decay characteristics, energies, radioactive growth, Bateman equation and solutions, distinguishing aspects due to half life differences and their utilization in measurements, diffusion in air and water, solubility in water. |
| | Quantities, Units, standards and Health Effects of radon ST 1 hr | Activity concentration units, concept of Potential Alpha Energy Concentration & units. Dose limits to workers and public due to technological activities, NORM residues, ICRP/IAEA/WHO limits, reference & action levels. Concepts of hazard and health risk, relative assessment of risk due to radon gas & decay products, effect of smoking on radon risks, historical health effects of radon. |
| Laboratory session 1/Tutorial 14:30 – 16:30 hrs | Familiarization of the methods/techniques KN+ST 2 hrs | Short-term tests, long-term tests, known exposure measurements, background measurements, duplicate measurements, routine instrument performance checks, operating procedures |
| Day 2 | | |
| Ssession, faculty, duration | Title of lecture | Brief contents lectures & expected skills to be developed from laboratory session |
| Lecture Session 2 | Decay products - formation, theory of attachment to aerosols and deposition ST 1 hr | Decay products: theories of attachment to aerosols, charge state, mechanisms of deposition on surfaces environment. |
| | Measurement techniques - Active methods | General considerations for passive & active methods. Double filter, scintillation cells, electrical chambers, continuous radon monitors online Rn/Tn monitors. |

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| | ST 1 hr | Grab sampling and programmed counting for decay products, WL monitors |
| | Measurement techniques - Passive methods | Passive methods: Alpha-Track Detectors - SSNTD based twin-cup systems, DRPS/DTPS, electret based systems, activated-charcoal adsorption devices, charcoal based liquid scintillation spectrometry (LSS) |
| | YSM 1 hr | |
| Laboratory session 2/Tutorial 14:30 – 16:30 hrs | Passive and active radon and thoron detection methods | Skills in the use of pin-whole detectors, SSNTD–preparation of the dosimeters, deployment, etc. Skills in the use of active devices - AlphaGuard, Rn-TnDUO, etc. |
| | KN+YSM 2 hrs | |

| Day 3 | | |
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| Ssession, faculty, duration | Title of lecture | Brief contents lectures & expected skills to be developed from laboratory session |
| Lecture Session 3 | New developments in measuring devices- new techniques for radon, thoron and their progeny | Details about the new measurement techniques and developed by Japanese scientists – principle, operation and calibration |
| | ST 1 hrs | |
| | Calibration, intercomparison, QA and QC | Calibration chambers, calibration measurements, quality checks, intercomparison exercises. Concepts of QA and QC, elements of a QA program for radon, responsibilities, quality management, QA documentation & reporting, analysis & interpretation of QC. |
| | ST 1 hr | |
| | Radon emission from soils and building materials, Measurement of fluxes and exhalation rate | Modeling transport in soils, flux measurement principle with accumulators, models of data interpretation, Back-diffusion corrections, use of continuous monitors, measuring emanation coefficient, closed can technique, limitations and errors, online methods. |
| | ST 1 hr | |
| Laboratory session 3/Tutorial 14:30 – 16:30 hrs | Direct reading progeny sensors, pinhole detectors (SSNTD)– exposure, etching and counting | Skills in the preparation of DTPS and DRPS – deployment in the field. Hands on experience in using the advanced direct reading progeny devices developed in Japan, |

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| | KN+YSM 2 hrs | calibration, etc. Skills in using the spart counter and calibration. Familiarization with LR-115 SSNTD films, hands on experience in etching the exposed films and counting using spark counters. |
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| Day 4 | | |
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| Ssession, faculty, duration | Title of lecture | Brief contents lectures & expected skills to be developed from laboratory session |
| Lecture Session 4 | Radon dosimetry ST 1 hrs | Lung model and lung deposition characteristics, dosimetric approach for the derivation of dose coefficients, comparison with epidemiological approaches |
| | Epidemiological studies YSM 1 hr | Miners studies, pooled data on 11 miners, basis of current dose coefficients. Residential radon epidemiolgy, pooled case-control studies, present staus of risk coefficients. |
| Laboratory session 4/Tutorial 14:30 – 16:30 hrs | Use of predictive models of decay product behavior in confined environments : Hands-on experience. YSM + KN 2 hrs | Skills in applying models for decay product behaviour |

| Day 5 | | |
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| Ssession, faculty, duration | Title of lecture | Brief contents lectures & expected skills to be developed from laboratory session |
| Lecture Session 5 | Radioactive aerosols – upgrade of dose assessment due to inhalation ST 2 hr | Discussion on sophisticated dose assessment methodology developed by Japanese radon research group discussed. Structures and approaches of lung model are discussed. |
| | Radon, thoron in workplaces and mitigation | Radiation protection practices Theoretical basis, Design & Operational aspects. Mitigation techniques: New techniques developed |

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| | YSM 1 hr | in India for thoron mitigation using activated charcoal |
| Laboratory session 5/Tutorial 14:30 – 16:30 hrs | Calibration experiments – using the state-of-the art radon calibration chamber ST+KN 2 hrs | Skills in the calibration techniques of measuring devices, techniques in using the calibration chamber. |

| Day 6 | | |
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| Ssession, faculty, duration | Title of lecture | Brief contents lectures & expected skills to be developed from laboratory session |
| Lecture Session 6 | National coordinated radon and thoron monitoring - Japan ST 1 hr | Protocol for the national studies, research teams, methodology adopted, important findings, national dose estimate - Japan |
| | National coordinated radon and thoron monitoring – India YSM 1hr | Protocol for the national studies, research teams, methodology adopted, important findings, national dose estimate in India |
| | Revisions, calculations, Evaluation test and closure of the course ST +YSM+KN 2 hrs | |

Course Faculty: **ST : Shinji Tokonami** **YSM : Y S Mayya** **NK: Karunakara N**

All communications may kindly be mailed to:

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