

Mangalore University



Global Initiative of Academic Networks (GIAN)

Ministry of Education, Government of India



Course No. 2464005

Advanced Alpha and Gamma Spectrometry for Applications in Environmental Studies

December 9 - 14, 2024

Organized by

Centre for Advanced Research in Environmental Radioactivity (CARER)
Mangalore University, Mangalagangothri, Mangalore, India

Brochure link: www.mangaloreuniversity.ac.in

Overview

The scope of this advanced course is to develop proficiency among the participants in the advanced techniques of alpha and gamma spectrometry for environmental studies. The course will address the challenges involved in the accurate determination of radionuclide activity concentration in terrestrial, aquatic (marine and freshwater ecosystem), atmospheric, and geological samples which is ever so important in studies on radioecology, impact assessments, emergency preparedness, application of natural and anthropogenic radionuclides as tracers for studying the environment and such other applications. The salient feature of the course is that it aims to train the participants in novel measurement techniques such as list-mode data acquisition, alpha-gamma coincidence measurements, and gamma-gamma coincidence measurements.

New techniques/methodologies and algorithms have been developed by the Radiation and Nuclear Safety Authority (STUK), Finland, STUK for precise calibration of alpha and gamma spectrometers (in particular, efficiency calibration for low energy gamma rays, unfolding overlapping peaks, interference/tail correction in alpha spectrum) and determination of activity concentration.

Participants will be trained on these new techniques/methodologies. The participants will be exposed to advanced equipment for high-resolution alpha and gamma-ray spectrometry systems and in-situ spectrometry systems. Hands-on training on advanced techniques for energy and efficiency calibration of the spectrometers, activity calculation, uncertainty determination, quality assurance, decay corrections, setting up of radiometric laboratory, novel measurement techniques such as list-mode data acquisition, alpha-gamma coincidences, gamma-gamma coincidences will be provided during the course with the facilities available at the Centre for Advanced Research in Environmental Radioactivity (CARER), Mangalore University. At the end of this course, the participants will learn about all the intricate details of utilizing advanced alpha and gamma spectroscopy techniques for the determination of radionuclide activity concentration in terrestrial, aquatic (marine and freshwater ecosystem) and atmospheric, and geological samples which are ever so important in studies on radioecology, impact assessments, emergency preparedness, application of natural and anthropogenic radionuclides as tracers.

The Centre for Advanced Research in Environmental Radioactivity (CARER), Mangalore University, is a national facility established jointly by the Board of Research in Nuclear Sciences (BRNS) and Mangalore University. This centre provides state-of-the-art alpha and gamma spectrometers for advanced research for PhD students, faculty and scientists from different institutions all over the country. The CARER is now offering R&D programmes mainly targeted for the benefit of users and this course would help to bring together all of those who are working in the field of application of radioisotopes as tracers to study environmental issues. The major focus of CARER is to assist researchers from other universities all over India with analytical and instrumental help to build human capital.

Objectives

- The objective is to develop proficiency and build capacity among the participants in the advanced techniques of alpha and gamma spectrometry with emphasis on efficiency calibration of the spectrometers, uncertainty determination, quality assurance, decay corrections, novel measurement techniques such as list-mode data acquisition, alpha-gamma coincidences, gamma-gamma coincidences,
- To prepare the next generation of high-quality nuclear physicists, and earth and environmental scientists who will lead the scientific research in India, by teaching them advanced techniques in alpha and gamma spectrometry for environmental/geological/emergency preparedness studies, and
- Build a research group for actively working on the above-referred topics with the Centre for Advanced Research in Environmental Radioactivity (CARER) of Mangalore University as the national centre and to assist researchers in other universities in India with their analytical needs.
- To initiate collaboration between CARER, Mangalore University and STUK, Finland.

Date and Registration Fee

Dates	December 9 – 14, 2024
Who can attend	Ph. D students, Post Graduate Students, faculty from Universities and research institutions, scientists from R&D laboratories and technical staff from industries.
Fees	<p>The participation fee for taking the course for different categories is as follows:</p> <p>Students : Rs. 1,000/- Faculty/scientist : Rs. 5,000/- Participants from industries : Rs. 10,000/- GST will be extra as applicable</p> <p>Instructional materials, computer usage, internet facility, lunch and session tea will be provided. Participants will be provided accommodation on the University campus on a payment basis subject to availability.</p>

Faculty

Dr. Roy Pöllänen is an adjunct professor in the physics department of the University of Helsinki. He works in the Radiation and Nuclear Safety Authority (STUK) of Finland as a senior inspector. His main research area is radiation measurements, especially nondestructive alpha spectrometry and gamma-ray spectrometry. Other areas of interest are environmental radiation monitoring and in particular air monitoring, atmospheric transport calculations, determination of radioactive particle characteristics, dose calculations, radiation hazard estimation, radiation detection methods in general and in-field measurements. Radiation measurements by using unmanned aerial vehicles, emergency preparedness, and organizing training and radiation detection exercises are other topics. During his 30-year career in STUK Roy Pöllänen has published more than 100 scientific papers and reports. He represents STUK in the International Committee for Radionuclide Metrology, ICRM, and he is active in various (inter)national research projects



His research interests are: radioactive materials released into the environment in nuclear incidents, environmental radioactivity, air monitoring, dose calculations, aerosol physics and analyses of radioactive particles, particle characteristics, atmospheric transport calculations and estimation of radiation hazards, development of sample analysis (spectrometric) methods - non-destructive alpha

spectrometry, detection of radiation sources, and in-field measurements.

Professor Karunakara Naregundi is the founder and Head of the Centre for Advanced Research in Environmental Radioactivity (CARER), at Mangalore University. He is also heading the Centre for Application of Radiation and Radioisotopes Technology (CARRT), Mangalore University, Mangalagangothri-574199, Mangalore, India and of Medical Physics Division of Mangalore University.



He is responsible for the establishment of CARER as a National Facility through funding from the Board of Research in Nuclear Sciences, Govt. of India. He has authored 140 research publications in journals and has ongoing research collaborations with leading scientific institutions in India and abroad. He served as Editor of the special issue of the Journal of Environmental Radioactivity, Elsevier (Volume 138, 2014). He has also served as an editorial board member for the Journal of Environmental Radioactivity. He is the recipient of the Sir C V Raman Award from The State Council for Science and Technology, Govt. of Karnataka (in the year 2017) and Dr A K Ganguly Award (in the year 2012) from the Indian Association for Radiation Protection (IARP). He is a member of the International Steering Committee to organise the International Conferences series on Polonium and radioactive Pb isotopes in the environment. He has served as an expert member in the IAEA missions to member countries.

Course Outline

Session/faculty/ duration	Brief contents lectures & expected skills to be developed from laboratory session
DAY 1	
Lecture Session 1 RP - 2hrs 10:00 – 12:30 hrs (30 min break)	Radionuclides and selected stable isotopes in the environment: Reactors, Radioisotope production, CTBT-relevant nuclides, Natural decay chains, Preparedness point of view. Radionuclide data: Need for obtaining high-quality data using alpha, and gamma-ray spectrometers.
Laboratory Session 1 NK+RP 2hrs 14:30 – 16:30 hrs	Introduction to nuclear spectrometer systems: Familiarization with different types of detectors of alpha spectrometry (Si surface barrier, passivated implanted planar silicon detector, ionisation chamber-based alpha spectrometers, etc.). Familiarization with different types of gamma detectors (HPGe, NaI(Tl), LaBr ₃ , Cs(I) etc.). Advantages of the different types of detectors and their applications. Signal processing and spectroscopy systems, spectroscopy (MCA) software, etc.

DAY 2

Lecture Session 2
RP
2hrs
10:00 – 12:30 hrs
(30 min break)

Alpha and gamma-ray interactions with matter: Photoelectric effect, Compton scattering, pair production, alpha-particle interactions and stopping power.

Equipment for high-resolution gamma-ray spectrometry: HPGe detector – different types and configurations of detectors and lead shields, electronics, Compton suppression systems, etc.

Laboratory Session 2
NK+RP
2hrs
14:30 – 16:30 hrs

High Pure Germanium (HPGe) detector: Concept, calibration, use of software. Energy calibration, identification of unknown radionuclides, and determination of activity in a sample.

DAY 3

Lecture Session 3
RP
2hrs
10:00 – 12:30 hrs
(30 min break)

Equipment for in-situ alpha spectrometry: High-resolution alpha spectrometer. Performing measurements at ambient air pressure.

Energy and efficiency Calibration of the spectrometers: General methodologies, importance of low energy calibration – principles and methods.

Laboratory Session 3
NK+RP
2hrs
14:30 – 16:30 hrs

High Pure Germanium (HPGe) detector: Advanced technique in efficiency calibration, self-attenuation correction, interactive peak fitting, corrections for summation and overlapping.

DAY 4

Lecture Session 4
RP
2hrs
10:00 – 12:30 hrs
(30 min break)

Alpha and gamma-ray energy spectra and activity calculation: Computer software for spectrum generation. Spectrum analysis. Details for activity calculation.

In situ spectrometry: In-situ alpha spectrometry, Gamma-ray spectrometry

Laboratory Session 4
NK+RP
2hrs
14:30 – 16:30 hrs

Alpha spectrometry: Operation, calibration, sample preparation, Alpha spectrum evaluation, tail correction, and good source preparation practises.

DAY 5

Lecture Session 5

RP

2hrs

10:00 – 12:30 hrs

(30 min break)

Uncertainty determination and quality assurance – 1: uncertainties in the efficiency calibration, uncertainties in the decay library data, uncertainties in the measurements, uncertainties of the corrections, and the new ISO/IEC 17025 standard.

Uncertainty determination and quality assurance -2: equipment used in the measurements, measurement conditions (environment), characteristics of the reference source, measurement geometry, data acquisition, spectrum analysis, and other points influencing the uncertainties.

Laboratory Session 5

NK+RP

2hrs

14:30 – 16:30 hrs

Field/in-situ gamma spectrometry, use of portable gamma spectrometer for in-situ measurements and aerial survey.

DAY 6

Lecture Session 6

RP

2hrs

10:00 – 11:00 hrs

(30 min break)

Decay corrections, Decay correction prior to the counting period, Decay correction during the counting period, Random coincidence summing correction, True coincidence summing correction, Correction for the self-attenuation, Correction for the source inhomogeneity, Correction for other source characteristics

Towards novel measurement techniques: List-mode data acquisition, alpha-gamma coincidences, gamma-gamma coincidences

11:30 – 13:00 hrs

Examination

Course Faculty: **RP : Roy Pöllänen** **NK : Karunakara Naregundi**

Contact:

Prof. Karunakara Naregundi

Course Coordinator

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Link for Registration: <https://forms.gle/o1KLC83Hg2r2QMF48>



Participants will be provided accommodation on a payment basis subject to availability.

Last date for registration: November 10, 2024

The course fees may be paid through NEFT Transfer to the bank account of the Finance Officer, Mangalore University. The bank details are as under:

Name	Finance Officer (M U CARER Generated Grants) Mangalore University, Mangalagangothri - 574199, Mangalore
Bank Name	State Bank of India
Bank Branch	Mangalagangothri, Mangalore University Campus, Mangalore - 574199
Branch Code	8034
A/C No.	34987236758
IFSC Code	SBIN0008034
MICR	575002010

After payment please mail the details of the payment to the course coordinator: Prof. Karunakara Naregundi, Centre for Advanced Research in Environmental Radioactivity (CARER), Mangalore University – 574199.

E-mail: carermu@gmail.com drkarunakara@gmail.com