Hands-On

Training Programmes

On

Sophisticated Instruments

Dr. K. C. Patel R & D Centre

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

CHARUSAT Campus, Changa – 388421, Dist. Anand, Gujarat, India

Website - KRADEL Link: https://kradle.charusat.ac.in/

2021

PREAMBLE

In the modern era like present and upcoming decade there is a tremendous growth in the industrial sector related to the exploitation of material developments. For this, synthesis of novel compounds and understanding their characteristics with respect to the quality assurance studies are of prime importance. The instruments in quality control laboratories plays vital role for fast processing and analysis of testing samples by minimizing the errors. This forces us to characterize these compounds using the cutting edge research instruments using standard and quality control protocols. The skilled personnel, who is trained for handling sophisticated instruments is another important aspect in the material characterizations. There is a challenge before universities to fulfill the demand of skilled human resources as the education given in academic institutions may not be fully acquainted with needs of today's growing industries.

The centre has housed to high-end sophisticated research equipment such as SEM, VSM, XRD, TGA, DSC, magnetorheometer, particle size analyzer, etc. which are normally not available at many academic institutions due to their high cost. The motive of training programme is to extend such facility to other users who does not have such facilities at their premises. By getting trained with such instruments not only they can pursue their scientific hunger but also complete their R&D activities in time and keeping themselves with the pace with the developments taking place globally.

We, the R & D persons working under the umbrella of university, cater the requirements of such industries and analytical laboratories by taking utmost care to design and develop a course which will provide in-depth knowledge of instrumentation, practical knowledge and skills of handling sophisticated instruments. These training programs are to motivate interested young researchers, post graduate students and research fellows from physics, chemistry, biology, pharmaceutical and engineering disciplines to spend their valuable time in gaining practical experience in the field of interest.

We thankfully acknowledge the PROVOST, Registrar, Research Advisors and the management of CHARUSAT for their guidance, constant support, encouragement and appreciation. By this course, we hope to increase an appetite in individuals for the sciences.

Dr. Kinnari Parekh, I/C Head, KRADLE

Objectives of the training programme

- To provide sophisticated instrumental facilities to scientists and academicians from various institutions, R&D laboratories and industries.
- To develop Hands-on Skills for working with cutting edge research instruments.
- To develop analytical skill.
- To develop capability for preventive maintenance of the sophisticated instruments.
- To produce skilled human resources.

KRADLE is equipped with different sophisticated analytical equipment's for meeting with the needs of researchers in all areas of Science and Technology. Any individual researcher or group of researcher from any academic institutions or Industrial R&D can utilize the services of these equipment facilities on nominal charges. The details about the procedure for using the facilities and the charges for sample analysis can be obtained from our website.

Besides providing analytical service, the KRADLE scientists are also involved in R&D activity of the institute with several ongoing projects. Students are also working for their Ph.D. degree and dissertation projects utilizing these modern analytical equipment facility.

For more detail please click here: https://kradle.charusat.ac.in/

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

Dr. K C Patel R & D Centre

Training Programme Modules

List of training programs: 2021

These programmes can be offered at different level for CHARUSAT faculty (of short duration), PhD scholars (semester long), summer programs (condensed course), etc.

Code no.	**Title of the training program**	**Program convener**	**Program Fee (Rs.)**	
			Individual Module	**Modules package**
RD 1001	Ionizing Radiation: Environment & Industrial applications	Dr. Kamesh Baskaran	1,500/-	7,000/-
RD 1002	FTIR Spectroscopy: Hands on basic level course Make: Thermo Scientific, USA Model: Nicolet 6700	Dr. Atanu Banerjee	1,500/-	
RD 1003	X-ray diffraction: Basic level course Make: Bruker, Germany Model: D2-phaser	Dr. Kinnari Parekh	3,000/-	
RD 1004	Scanning Electron Microscopy: Real-time training Make: JEOl, Japan Model: JSM-6010LA	Dr. Vanarajsinh Solanki	3,000/-	

Certificate will be awarded to successful candidate who will attend at least 85% lectures, practical, complete the assignments and will qualify the examination with minimum 65%.

This course can be offered by KRADLE to all research scholars of CHARUSAT and outside CHARUSAT University. The mid carrier academician as well as scientists can also be participate, if required.

Training code:	**Program Title: Ionizing Radiation: Environment & Industrial applications**	
RD-1001		
Credit: 2	**Total Hours: 20**	**Batch Size: 10 persons**

Course Convener: Kamesh Viswanathan Baskaran

Dr Kamesh Viswanathan Baskaran is a research scientist at Dr K.C. Patel Research and Development Centre, Charotar University of Science & Technology (CHARUSAT). His research expertise in the field of radio-analytical nuclear chemistry, geographical information system based environmental monitoring and assessment, and radiation biology. He has B.Sc. Microbiology from University of Madras and M.Sc. Biotechnology from Sathyabama Institute of Science and Technology, Chennai. His PhD Biotechnology (Eng.), from SRM Institute of Science and Technology, Chennai. Before joining as faculty at CHARUSAT, he worked as postdoctoral fellow from Laval University, Quebec, Canada in hard to detect radionuclides in ICP-MS/MS under Professor Dominic Lariviere. He has publications from national and international journals and conference proceedings in the field of radionuclide measurement of ionizing radiations.

Objective of the Course:

- To realize the concepts of ionising radiation (alpha, beta and gamma).
- To understand the concepts of radionuclides measurement and its detection methods.
- To aware the safe handling of radioisotopes in research and industrial applications.

INTENDED PARTICIPANTS:

- Participants interested to seek and learn ionizing radiation from basic level.

PREREQUISITES:

- Basic understanding of radiation types.

COURSE OUTCOME:

- **At the end of this course, participants will be able to understand:**
    1. The basics of ionizing radiation and its detection.
    2. The concepts of radiation units, calculation of activity and analysis.
    3. The knowledge of radiation safety aspects.

Training Modules (TM):	**Hours**
TM 1:	**4 hrs**
1. What is Ionizing Radiation?	
2. Differences between artificial and natural radionuclides	
3. How to detect and measure ionizing radiation?	
TM 2:	**4 hrs**
1. Ionizing radiation effects of living and non-living things.	
2. How to monitor and protect from radiation in humans?	
TM 3:	**2 hrs**
1. Regulation aspects for ionizing radiation in laboratory and industry.	
2. Applications in food, environment, and health.	
3. How to select of radionuclides for ionizing radiation in environmental and industrial applications.	
TM 4:	**10 hrs**
1. Simulation based radiation dosimeters and gamma spectrometry.	
2. Estimating the radionuclide activity and dose rate to effective dose.	

Recommended Study Material/Reference books:

1. Ehmann, W. D., & Vance, D. E. (1991). Radiochemistry and nuclear methods of analysis. New York: Wiley.

2. International Atomic Energy Agency. (2011). Cytogenetic dosimetry: applications in preparedness for and response to radiation emergencies. IAEA.

3. Martin, C. J., & Sutton, D. G. (Eds.). (2015). *Practical radiation protection in healthcare*. Oxford University Press, USA.

4. Miller, K. L. (1992). *CRC handbook of management of radiation protection programs*. CRC Press

Course Evaluation pattern.

MCQ Exam: 40 marks, Practical Exam: 40 marks, Presentation/Assignment: 10 marks, Viva voice: 10 marks.

Course Fee: **Rs.1500/-**

Training code: **Program Title: FTIR Spectroscopy: Hands on basic level course**

RD-1002

Credit: 2 **Total Hours: 20** **Batch Size: 10 persons**

Course Convener: Dr. Atanu Banerjee

Dr. Atanu Banerjee is an associate Professor in Dr. K C Patel Research and Development Centre (KRADLE) at CHARUSAT. He is mainly focusing his research in the field of Synthetic Inorganic (CO2 fixation, spin-crossover etc.) and Bio-inorganic (Biomimetic model studies of metalloenzyme active site) Chemistry. He achieved M.Sc. degree in Chemistry and Ph.D in Coordination Chemistry from Jadavpur University, Kolkata, India. Before he joined CHARUSAT, Dr. Banerjee worked 9 years as a Postdoctoral Research Associate at Oakland University, Michigan, USA and TU Kaiserslautern, Germany. He has published more than 25 articles in international repute journals and 2 book chapters.

Aim of the course: Our physical capability cannot understand the whole electromagnetic spectrum and these thoughts allow us to see further by different spectroscopic technique. Electrons in their excited state disclose a lot about matter and spectroscopy help us to discover the fact. In this training program we will introduce the theory underpinning FTIR spectroscopy and its applications from chemistry, physics, biology to medical science.

Objective of the Course:

- To impart the theoretical and practical perspective of infrared spectroscopy.
- The participants will be equipped with the knowledge and skills to meet their learning needs independently.
- Applications of spectroscopy in the field of chemistry, physics, biology to medical science.

INTENDED PARTICIPANTS:

- Persons desire to obtain the conceptual and instrumental understanding in this area.

PREREQUISITES:

- Basic understanding of spectroscopy.

Course structure	**Hours**
Module-1 (Theory)	**4 hrs**

Introduction:

What is spectroscopy? Impact of electromagnetic radiation on molecules!

Different kind of spectroscopy, Relation between the Wavelength and Wavenumber

FTIR Spectroscopy:

Short historical development of optical Infrared (IR) spectroscopy, Basic Principle of IR Spectroscopy, Different kinds of IR Spectroscopy: •Fourier-Transform Infrared Spectroscopy (FTIR) •Attenuated Total Reflection (ATR) Spectroscopy •Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS), What is Raman Spectroscopy and how it differs from IR Spectroscopy? Advantages and limitations, Instrumentation and Applications

Module-2 (Operational part/Hands-on training for real sample measurements) 10 hrs

FTIR Spectroscopy: Software, Sample preparation, (KBr Pellet), Measurement, Data processing

Module-3 (Analysis) Interpretation and Data analysis from samples spectrum 6 hrs

FTIR Spectroscopy: Interpretation of Spectra (Characteristic frequencies and assignment of different functional groups

COURSE OUTCOME:

At the end of this course, participants will be able to understand:

- Basic concept of vibrational and electronic spectroscopy
- Standardization/calibration of the instrument.
- How spectroscopy can be implemented in field oriented as well as multidisciplinary research
- Acquire knowledge for result/data interpretation

Recommended Study Material/Reference books:

1. C.N. Banwell and E.M. Mc Cash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition., Tata McGraw Hill, New Delhi.
2. R.M. Silverstein and F.X. Webster, 2003, Spectroscopic Identification of Organic Compounds, 6th Edition. John Wiley, New York.
3. G.M. Barrow, 1984, Introduction to Molecular Spectroscopy. McGraw-Hill Book Co.

Course Evaluation pattern.

The evaluation comprises of presentation (50%), MCQ (25%) and assignment given (25%).

Course Fee: **Rs.1,500/-**

Training code: **Program Title: X-ray diffraction: Basic level course**

RD-1003

Credit: 2 **Total Hours: 20** **Batch Size: 10 persons**

Course Convener: Dr. Kinnari Parekh

Kinnari H. Parekh, I/C Head and Senior Research Scientist, has received her PhD degree in Physics in 1999 from Bhavnagar University, Bhavnagar. She was an assistant professor at M S University of Baroda (2003 to 2009) and then at Indian Institute of Technology Gandhinagar (2008 to 2011). From 2011 onwards she has joined Charotar University of Science & Technology, Changa. She has published more than 80 papers in international journals, 2 patents, 1 book chapter published by the CRC Press, more than 80 presentations at international conferences. About 1070 citations (WOS), h = 17. She works on the application oriented synthesis and characterization of magnetic fluids for engineering and biomedical fields. Specialist in large scale production of magnetic fluids. She is a recipient of BOYSCAST award and DST young scientist award in terms of FTPYS project. She has been invited as visiting scientists at Sweden, South Korea, Brazil, Slovakia to work on different projects.

Aim of the course: One cannot see the X-rays as well as the atomic arrangement in different materials. However, the interaction of X-rays with matter discloses a lot about material properties and help us to know the structure of different types of materials. In this training program we will introduce the theory underpinning X-ray diffraction and its applications from chemistry, physics, biology, engineering to material scientists.

Objective of the Course:

- To impart the theoretical and practical perspective of X-ray diffraction.
- The participants will gain the knowledge and skills to meet their learning needs.
- Applications of X-ray diffraction in the field of chemistry, physics, biology to material science.
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INTENDED PARTICIPANTS:

- UG/PG/PhD students in Physics, chemistry Metallurgy, Nano Science & Nanotechnology, Chemical Engg, Aerospace Engg, Material Science and Mechanical Engg. etc., R&D personals in industries.

PREREQUISITES:

- Basic crystallography / solid state physics knowledge.

Content of the Module:	**Hours**
Theory	**7hrs**
Geometry of crystals, Reciprocal lattice, Basics of X-rays, Production and detection of X-rays, X-ray diffraction, X-ray diffraction methods, Diffractometer measurements, Intensity of diffracted beam, Determination of crystal structure, lattice parameter, crystallite size,etc.	
Operational part	**6hrs**
Sample preparation and its importance, Hands-on skill development for different samples (powders, thin film, composites)	
Analysis	**7hrs**
Qualitative & Quantitative phase analysis, structural identification, crystallite size & lattice parameter determination, Exercise	

COURSE OUTCOME:

At the end of this program, student will be able to understand:

1. Basic theory of XRD.
2. Handle and record the readings independently.
3. Sample Preparation and its effect on results.
4. Understanding structural analysis and their applications.
5. Analyzing and interpreting unknown samples.

Recommended Study Material/Reference books:

1. 1. X-ray Diffraction, A practical Approach by C Suryanarayana & M Grant Norton, Plenum Press, New York, 1998.
2. Elements of X-ray diffraction by B D Cullity, Addision Wesley, 1956.

Course Evaluation pattern.

MCQ+ written test: (20%) ;Problem solving (30%) ; Presentation (50%)

Course Fee: **Rs.3000**

Training code:	**Program Title: Scanning Electron Microscopy: Real-time training**	
RD-1004		
Credit: 2	**Total Hours: 20**	**Batch Size: 10 persons**

Course Convener: Dr. Vanaraj Solanki

Dr. Vanarajsinh Solanki is a research scientist in the Dr. K.C. Patel Research and Development Centre Department (KRADLE) of Charotar University of Science and Technology, Changa, Gujarat. He works in the areas of porous material synthesis for multifunctional applications in gas sensing, battery, photodetection, biomedical applications, photocatalysis etc. He is master in physics from Sardar Patel University, Vallabh Vidhyanagar, Gujarat, and a PhD in Experimental Condensed Matter Physics from Institute of Physics, Bhubaneswar. Before he joined as a research Scientist at KRADLE, he was at Materials Research Centre, Indian Institute of Science, Bangalore as a DST- National Postdoc Fellow. He has published more than 30 research articles in International Journals.

Aim of the course:

Human eyes are limited to resolve the structures smaller than 200 μm (sizes matching with visible wavelength of the electromagnetic spectrum) and hence required to have a high resolution instrument like scanning electron microscope (SEM) to unwrap the mysteries that nature have created at nanoscale. SEM is capable to resolve the nanoscale objects and useful for understanding material's size and shape dependent applications. In this programme, attendees will come across fundamental concepts of SEM and its application for physics, chemistry, material science etc.

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Objective of the Course:

- To provide assistant to researchers/students on scanning electron microscopy
- To make students competent, research level microscopist

INTENDED PARTICIPANTS:

Curious persons to obtain the conceptual and instrumental understanding with first-hand experience

PREREQUISITES:

- Basic knowledge of surface structures of any object/sample.

Course structure	**Hours**
Theory:	**5 hrs**
Introduction	
About microscopy, Importance of microscopy, Microscopic techniques	
Scanning Electron Microscopy	
Introduction to SEM, Resolution and Abbe's equation, Particle matter interaction: Primary electrons, Secondary electrons, Auger electrons, X-ray continuum, Back-scattered electron, Characteristic X-ray, Construction of SEM and its component, Vacuum system	
Hands-on/First-hand experience:	**10 hrs**
Real time training on SEM	
• Sample preparation, Measurement	
Analysis:	**5 hrs**
• Interpretation of SEM image	
COURSE OUTCOME:	
• Basic concept of microscopy • Instrument handling experience. • How microscopy can be implemented in field oriented as well as multidisciplinary research. • Knowledge of SEM image analysis.	
Recommended Study Material/Reference books:	
1. O. C. Wells, Scanning Electron Microscopy, McGraw-Hill, New York (1974). 2. C. W. Oatley, The Scanning Electron Microscope, Cambridge University Press, Cambridge (1972).	
Course Evaluation pattern.	
The evaluation will be done by considering the presentation Quiz/test/viva (70 %) and assignments (30%).	
Course Fee:	**Rs.3000/-**

Charotar University of Science and Technology

EQUIPMENT SPECIFICATIONS

Sr. No.	Instrument	Specifications	Make and Model	Instrument In-charge / Contact ID
1.	Powder X-ray Diffractometer	Table top model with Lynux-eye detector. Sample type: powder/thin film	Make: Bruker, Germany Model: D2-phaser	Dr. Kinnari Parekh / Dr. R V Upadhyay kinnariparekh.rnd@charusat.ac.in
2.	Fourier Transform Infrared (FTIR) Spectrometer	Solid sample, KBr method, Sample type: powder	Make: Thermo Scientific, USA Model: Nicolet 6700	Dr. Atanu Banerjee atanubanerjee.rnd@charusat.ac.in
3.	Scanning Electron Microscope (SEM)	five axis goniometer, Two axes (X, Y) motorized stage , SEI: Secondary Electron Detector, BEI: Back scattered Electron detector , SNS: Stage Navigation System. IR CCD Camera Sample type: liquid/thin film/powder	Make: Jeol, Japan Model: JSM-6010LA	Dr. Vanaraj Solanki vanarajsolanki.rnd@charusat.ac.in