Nuclear Engineering

Nuclear Engineering Laboratories

Lab Name	Location	Person in Charge	Programs Served	Courses Served
Radiation Detection Laboratory	M12-010	• Ahmad Ababneh	• Nuclear Engineering	• Nuclear Sci. Eng. Lab I • Nuclear Instrum. & Meas • Nuclear Engineering Materials • Reactor Thermal Hydraulics • Senior Design Project
Applied Radiation Measurement Laboratory	M12-009	• Samar Ahmed	• Nuclear Engineering	• Nuclear Sci. Eng. Lab II • Elements of NE and Rad. Science course • Senior Design Project

RADIATION DETECTION LABORATORY

INTRODUCTION

This Laboratory provides an introduction to measurements common in Nuclear Engineering. Students will learn the operation of gas-filled and solid state detectors; scintillation detectors for gamma, neutron radiation and charged particles. Counting techniques and nuclear statistics, pulse shaping and spectroscopic analysis of radiation. Students will become skilled at connecting the different components of a nuclear system. The laboratory also includes advanced equipment for radiation detection and material properties.

EQUIPMENT AND INSTRUMENTS

- Detectors
  - o Gieger Muller
  - o Sodium Iodide
  - o Ion Implanted Detector
  - o Silicon Surface Barrier Detector
  - o High Purity Germanium
  - o Silicon (Li)
- NIM Modules
  - o Amplifier
  - o Gate and Delay Generator
  - o Time-to-Amplitude Converter
  - o Analog to Digital Converter
  - o Single Channel Analyzer
  - o Pulse Inverter
  - o Counter and Timer
  - o Universal Coincidence
  - o Preamplifier
- Liquid Scintillation Counter with Sample Oxidizer

Liquid scintillation counting (LSC) is the standard laboratory method to quantify the radioactivity

of low energy radioisotopes, mostly beta-emitting and alpha-emitting isotopes. It works by measuring the activity of a sample of radioactive material which uses the technique of mixing the active material with a liquid scintillator, and counting the resultant photon emissions.
The 307 Sample Oxidizer provides a simple, automatic method of preparation for samples for liquid scintillation counting. The instrument combusts the sample material to achieve physical separation of 3H and 14C radionuclides into two separate counting vials.

• Alpha Beta Counter System

The LB4200 is a Multi-Detector Gas Flow Proportional Counter (GFPC) for alpha/beta analysis .The LB4200 has the lowest published background specifications of any commercially available alpha/beta system using a 5.7 cm (2.25 in.) diameter gas flow proportional detector.

• Thermal Gravimetric Analysis System

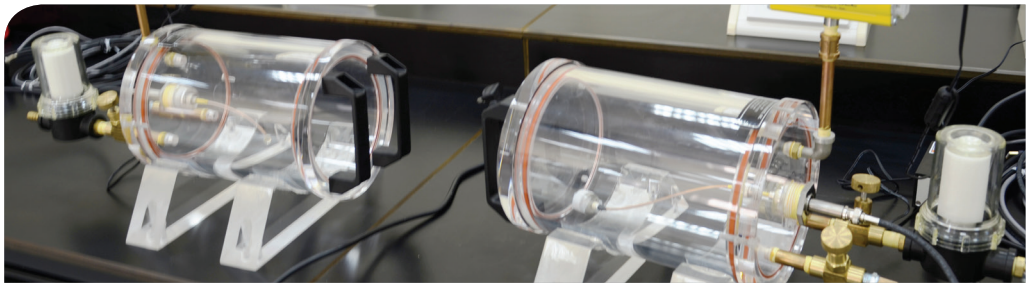
Thermogravimetry (TGA) measures weight changes in a material (subjected to temperature variation in a controlled atmosphere). Properties measured by thermogravimetry (TGA) include corrosion, pyrolysis, and adsorption/ desorption, loss of solvent, oxidation/ reduction, and hydration/ dehydration. Its applications include studies on oxidation/ corrosion of metals and alloys, reaction between a material and a gas, isothermal stability of materials under particular atmospheres and phase transitions of metals.

• Others
  o Metallurgical Optical Microscope
  o Multichannel Analyzer and Spectroscopy Software
  o Oscilloscope
  o Radioisotopes

EXPERIMENTS

- Introduction to Electronic Signal Analysis in Nuclear Radiation Measurements
- Geiger Counting
- Gamma-Ray Spectroscopy Using NaI(Tl)
- Alpha Spectroscopy with Surface Barrier Detectors
- Energy Loss of Charged Particles (Alphas)
- Beta Spectroscopy
- High-Resolution Gamma-Ray Spectroscopy
- High-Resolution X-Ray Spectroscopy
- Gamma-Gamma Coincidence
- Air Monitoring
- Determination of the Tritium Concentration in Soil Samples
- Determination of Gross Alpha and Gross Beta Activities in Different Water and Food Samples
- TGA Oxidization/ Heating-Cooling Effect on Samples

APPLIED RADIATION MEASUREMENT LABORATORY



INTRODUCTION

This Laboratory enhances the laboratory skills pertinent to Nuclear Engineering through performing experiments related to X-Ray Fluorescence, Gamma- Gamma Coincidence, half-life measurements, scattering of alpha particles, Compton scattering and pair production. The students will learn how to use the integrated detection systems that are practically used in engineering applications.

EQUIPMENT AND INSTRUMENTS

- Integrated Digital Signal Processing-Based Instrument with the Following Detectors
  - o Sodium Iodide Detector (2x2 inch)
  - o Sodium Iodide Detector (3x3 inch)
  - o Sodium Iodide Detector (6x6 inch)
  - o Sodium Iodide Detector (3x5x16 inch)
  - o Sodium Iodide Detector (Well Detector)
  - o Alpha Detector
  - o Broad Energy Germanium Detectors (BEGe)
  - o Reverse Electrode Coaxial Ge Detectors (REGe)
  - o X-Ray Energy Detector
  - o BF3 Neutron Detector
  - o He3 Neutron Detector
- DD Neutron Generator

  The DD generator uses the D-D fusion reaction and is driven by an ion beam supplied by a high current microwave ion source. The generator is enclosed in a radiation shielding/ moderator structure designed for high thermal neutron flux with adequate public safety from gamma and neutron radiation. The generator can be operated in either pulsed or continuous mode. Neutron yields of up to 109 n/s can be produced by the generator.
- Others
  - o Prospect (Basic Gamma Spectroscopy Software)
  - o Genie 2000 ((Advance Gamma Spectroscopy Software)

- o ISOCS (Efficiency Calibration Software)
- o Lynx (Digital Signal Analyzer)
- o Osprey (Universal Digital MCA Tube Base)
- o Oscilloscope
- o Radioisotopes

EXPERIMENTS

- Time Coincidence Techniques and Absolute Activity Measurements
- X-Ray Fluorescence Analysis Calibration and Energy Resolution
- Qualitative X-Ray Fluorescence Spectroscopy for Unknown Sample
- Gamma-Gamma Coincidence
- Alpha-Gamma Coincidence
- Rutherford Scattering of Alphas from Thin Gold Foil
- Compton Scattering
- Pair Production
- Half Life Measurement
- Gamma Ray Efficiency Calibration
- Prompt Gamma Neutron Activation Analysis (PGNAA)
- Neutron Activation Analysis (NAA)
- Inelastic Neutron Activation Analysis (INAA)
- Fast and Thermal Neutron Radiography
- Prompt Gamma Coincidence Measurements