Radiation Safety Associates, Inc.
HEALTH PHYSICS TECHNICIAN LEVEL II -- ADVANCED COURSE OUTLINE

BASIC MATHEMATICS & SCIENCE REVIEW
- Mathematics review
  - Scientific notation
  - Significant figures
  - Consistency of units
  - Graphing practices
  - Power functions
  - Exponential functions
  - Trigonometric functions
- Basic physics review
  - Structure of matter
  - Newtonian mechanics
  - Electricity
  - Electronics
- Other sciences
  - Biology
  - Chemistry

THEORY OF RADIOACTIVITY
- Atomic structure
  - Thomson model
  - Rutherford model
  - Bohr model
- Nuclear structure
  - Nuclear model
  - Nuclear stability
  - Binding energy
- Nuclear decay processes
  - Radioactivity
  - Alpha decay
  - Beta decay
  - Gamma ray emission
  - Fission decay
  - Radioactive decay law

INTERACTIONS OF RADIATION WITH MATTER
- Neutron interactions
  - Introduction
  - Slow neutron interactions
  - Fast neutron interactions
- Photon interactions
  - Introduction
  - Photoelectric effect
  - Compton scattering
  - Pair production
- Absorption & attenuation Coefficients
- Charged particle interactions
  - Energy loss mechanisms
  - Stopping power
  - Specific ionization
  - Range of a charged particle
  - Linear energy transfer

BIOLOGICAL EFFECTS OF RADIATION
- Radiation effects on water
  - Primary reactions
  - Secondary reactions
  - Pre-irradiation chemical protection
  - Radiation effects on cells
  - Cell structure
  - Radiation effects
  - Human biodosimetry techniques
  - Cell radiosensitivity theories
  - Relative biological effectiveness
- Radiation effects on human organs
  - Blood system
  - Gastrointestinal system
  - Central nervous system
  - Reproductive system
  - Conclusions
- Whole body effects in humans
  - Acute effects
  - Human late effects-genetic
  - Human late effects-somatic
  - Effects of chronic irradiation conditions
  - Radiation hormesis
  - Whole body radiation risk
  - Dose-effect models for radiation risk
  - Post-irradiation treatment of radiation injury
  - Radiobiological basis for ALARA

RADIATION QUANTITIES & DOSIMETRY CALCULATIONS
- Radiation quantities & units
  - Introduction
  - Activity
  - Exposure
  - Absorbed dose
  - Dose equivalent & equivalent dose
  - Effective dose equivalent & effective dose
  - Committed dose equivalent family
  - Roentgen/rem conversion factors
  - Radiation dose calculations
  - Point gamma ray sources
  - Bragg-Gray theory
  - Neutron dosimetry
  - Skin dose from beta emitters

RADIATION SOURCES
- Natural radiation sources
  - Introduction
  - External terrestrial
  - Internal terrestrial
  - Cosmic radiation
  - Radiation in space
  - Naturally occurring radioactive material (NORM)
- Artificial radiation sources
  - Fallout
  - Electronic product radiation
  - Product radioactivity
  - X-ray tubes
  - X-ray machine applications
  - Nuclear radionuclide applications
  - Nuclear particle accelerators
  - Nuclear reactors
  - Department of Energy weapons production
- Miscellaneous industrial sources
  - Isotopic neutron sources
  - Oil well logging
  - Radiation sterilization
  - Summary

RADIATION DETECTORS
- Detection mechanisms
- Gas-filled radiation detectors
  - Characteristic curve
  - Ion chambers
  - Proportional counters
  - Geiger counters
- Liquid radiation detectors

- Liquid scintillation counters
- Superheated drop detectors

Solid radiation detectors
- Scintillation counters
- Semiconductor counters

EXTERNAL PERSONNEL DOSIMETER SYSTEMS

The ideal personnel dosimeter

Photographic badge systems
- Basic principles
- Film response to radiation
- Film badge holder design

Thermoluminiscence badge systems
- Principle of thermoluminescence
- Characteristics of lithium fluoride
- Characteristics of lithium tetraborate
- Characteristics of calcium sulfate
- Neutron response of TLD phosphors
- TLD badge systems
- Hybrid badges

Radiation badge performance testing

Criticality badges
- Criticality accidents
- Criticality badge principles
- Criticality badge holders

Special applications

U.S. regulatory requirements

INTERNAL DOSIMETRY TECHNIQUES

Bioassay techniques
- Basic principles
- Practical bioassay applications
- In vivo counting techniques
- Basic principles
- Liquid scintillation whole body counter
- Solid crystal scintillation whole body counters
- Partial body in vivo counters
- Data analysis complications

Intake calculations
- Single uptake events
- Multiple or continuous uptakes

Internal dosimetry calculations
- Basic principles
- Mathematics of clearance
- The ICRP Internal Dosimetry Models
- Practical internal dose calculations
- Dose calculation for embryo/fetus

Summation of external & internal dose
- Introduction
- Compliance reporting of dose

ENVIRONMENTAL MONITORING PROGRAMS & EQUIPMENT

Monitoring programs
- Introduction
- Pre-operational & post-operational Programs
- Monitoring program examples

Environmental Instruments
- External gamma radiation
- Surface deposited activity
- Air sampling instruments---particulates
- Air sampling instruments-gases
- Measurements of radon gas in buildings
- Water sampling
- Food sampling

Environmental problem areas
- Radon & public health
- Dose-reconstruction principles
- Some environmental restoration projects

PROTECTION PRINCIPLES, SHIELDING & TRANSPORT

Basic principles
- The ALARA philosophy
- ALARA program planning
- Control of exposure time
- Exposure control through distance

Shielding design
- Gamma ray shielding
- Beta ray shielding
- Neutron shielding

Applied shielding examples
- Nuclear reactors
- Medical facilities
- Industrial radiography
- Nuclear particle accelerators

Transporting radioactive packages
- Introduction
- Packaging
- Labeling
- Markings & Shipping Papers

Internal Protection
- Introduction
- Respirators
- Fume Hoods
- Glove Boxes

SURVEYS, CALIBRATIONS & DATA ANALYSIS

Principles of monitoring & calibration
- Introduction
- General calibration principles
- Alpha radiation monitoring
- Gamma radiation fields
- Beta radiation fields
- Mixed beta-gamma radiation fields
- Neutron radiation fields
- Removable radioactive surface contamination

Decommissioning nuclear facilities
- Introduction
- Decommissioning surveys
- Survey plan
- Survey techniques
- Data interpretation

Counting statistics for data analysis
- Introduction
- Count rate & its error
- Confidence level
- Background corrections
- Detection sensitivity-LLD & MDA
- Interpretation of final clearance survey results

RADIOACTIVE WASTE MANAGEMENT

Sources & disposition of radioactive waste
- Radioisotope use
- The nuclear fuel cycle
- Existing disposal sites

Radioactive waste management principles

Applied processing techniques
- Concentration of solids
- Solidification of high level liquids
- Mixed waste
- Long term storage methods

Course offered at our Hebron, Connecticut facility in rotation with other radiation safety courses. For more information, see our website at http://www.radpro.com/training/, or contact us at 860.228.0487.