Prepare for the NRRPT Exam **(onsite course delivery only)**

COURSE DESCRIPTION

The NRRPT Certification Examination Review course is designed to provide the technical and practical information necessary for preparing practicing Health Physics Technologists to take the Registration Examination administered by the National Registry of Radiation Protection Technologies (NRRPT). The course covers all major elements in an operational Radiological Protection Program and includes a review of basic mathematics, practical problem-solving, radiation and radioactivity, and applied health physics. In addition, it examines the applicable regulations. This course provides 5 days review of the mechanisms of radiation, interactions and health effects, the operational aspects of radiological protection, and the development and implementation of methods and practices to evaluate the hazards from radiation and radioactivity. Class discussions on topics and cases brought by students will be supplemented by a strong emphasis on problem solving exercises and discussions to enhance student understanding.

TOPICS

BOARD CERTIFICATION EXAMINATIONS & TEST TAKING STRATEGY

- Why Certification?
- NRRPT Certification
  - Salary Differential
  - History of NRRPT
  - History of the Examination
  - Passing Point
  - Eligibility
  - Exam Structure and Content
  - Suggested Study Schedule

- General Advice
  - Application for Examination
  - Allowed Calculators
  - Learning
  - Computer Programs
  - Travel Planning
  - The days before the Examination
  - The day of the Examination
  - Multiple Choice Question Strategies
  - Word Problem Strategies
  - Scheduling Your Performance

USING UNITS AND DIMENSIONS

- Units and Dimensions
  - Primary Units
  - Secondary Units
- Special Units
  - Pressure
  - Temperature
  - Energy
- Manipulating Units
- Exponential and Unit Notation
- Orders of Magnitude
- Fundamental Conversions
- Radiological Unit Conversions
- Greek Alphabet

MODERN PHYSICS: ATOMIC AND NUCLEAR STRUCTURE

- Definitions (nuclear and atomic components)
- Rutherford Atom
- Bohr Atom
- Simple Atomic Model and Notation
- Electrons in Bohr Atom
- Chemical Properties of Elements
- Wave-Particle Duality
- Planck's Law
- Electromagnetic Spectrum
- Electronic Transitions
- Energy-mass Equivalence and Relativity
- Nuclear Models

NUCLEAR ENERGETICS

- Conservation Laws and Mathematical Treatment
- Conservation of Charge and Number of Nucleons
- Conservation of Energy and Mass
- Determinants of Nuclear Stability
  - Line of Stability
  - Binding Energy
  - Mass Defect
  - Binding Energy per Nucleon
  - Fission and Fusion
  - Q
- Conservation of Momentum
  - Simple Particulate Emission
  - Simple Photon Emission

TYPES OF RADIOACTIVE DECAY

- Electromagnetic Emissions
  - Gamma Ray Emission
  - Metastable States
  - Internal Conversion
  - X-Ray Emission
  - Auger Electron Emission
- Particulate Emissions
  - Beta Decay
  - Positron Decay
  - Electron Capture
  - Alpha Decay
  - Decay of Neutrons
  - Other Emissions

- Fission

RADIOACTIVE DECAY DATA

- Radiological Health Handbook
- Table of the Isotopes
- ICRP 38
- Chart of the Nuclides
  - Decay Equations
  - Decay Chains
  - Nuclear Reactions
- Trilinear Chart of the Nuclides

ACTIVITY AND HALF-LIFE

- The Basic Law of Decay
- Definition of Activity
- Definition of Half-Life
- Identifying Radionuclides Using Half-Life
- Emitted vs. Detected Radiation
- Relationship between Half-Life and Activity
- Activity Problems
  - Atom Percent
  - Weight Percent
  - Specific Activity
- Magnitudes of Activity
- Radionuclides of Interest
- Strontium Units
- Working Levels

DECAY KINETICS AND COMPARTMENTAL MODELS: LONG CHANS AND DYNAMIC CHANGES

- Long Decay Chains
  - Equilibrium Approach
  - Bateman with Long Times
- Changing Kinetics
  - Dealing with Step Changes in Kinetics
  - Radionuclide Generator Elution
- Fission Products as a Function of Time
- Summary of Special Kinetics Equations

DECAY KINETICS AND COMPARTMENTAL MODELS: SPECIAL CASES

- Special Cases of Equilibrium
  - Secular Equilibrium
  - Transient Equilibrium
  - No Equilibrium
  - Maximum Progeny Activity
- Summary of Formulae

DECAY KINETICS AND COMPARTMENTAL MODELS: LONG CHAINS AND DYNAMIC CHANGES

- Long Decay Chains
  - Equilibrium Approach
  - Bateman with Long Times
- Changing Kinetics
  - Dealing with Step Changes in Kinetics
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- Fission Products as a Function of Time
- Summary of Special Kinetics Equations

RADIATION INTERACTIONS: CHARGED PARTICLES

- Types of Charged Particles
- Types of Charged Particle Interactions
  - Excitation & Characteristic X-Ray Production
  - Ionization
  - Bremsstrahlung
  - Elastic Scattering
  - Nuclear Reactions
  - Annihilation Reactions
  - Cerenkov
- Transmission of Charged Particles Through Material
  - Specific Ionization
  - Stopping Power
  - Linear Energy Transfer (LET)
  - Range
  - Range Relationships
- Charged Particle Detection Mechanisms

RADIATION INTERACTIONS: PHOTONS

- Types of Photon Interactions
  - Classes of Interactions
  - Categories of Scattering
  - Photoelectric Effect
  - Compton Scattering
  - Pair Production
  - Photodisintegration
  - Summary of Secondary Radiations
  - Monte Carlo and Related Methods
- Transmission Through Material
  - Definitions
  - Half Value Layer
  - Relaxation Length (mean free path)
  - Density Area Thickness
  - Attenuation Coefficient
  - Absorption Coefficients
  - Energy and Z-dependence of Coefficients
  - Interpolating/Extrapolating Coefficients
  - Values of Coefficients
  - Predominant Interaction Types
- Photon Detection Mechanisms

RADIATION INTERACTIONS: NEUTRONS

- Neutrons
  - Properties of Neutrons
  - Neutron Energy Classifications
- Neutron Production (Sources)
  - Decay
  - Photodisintegration
  - Alpha-Induced Reactions
  - Fission
  - Fusion
  - Particle Accelerators

    - Spallation
    - Other
- Neutron Interaction Types
    - Elastic Scattering
    - Inelastic Scattering
    - Absorption
    - Fission
- Neutron Cross Sections
    - Concept of Cross Section
    - Types of Cross Section Data
    - Sources of Cross Section Data
    - Elastic Scattering Cross Section
    - Inelastic Scattering Cross Section
    - Thermal Neutron Absorption Cross Section
    - (n, alpha) Reactions
    - Fission
- Important Neutron Interactions
    - Production of N-15 in Nuclear Plants
    - Tritium Production
    - Boron Neutron Capture Therapy
    - Tissue Interactions
    - Biological Dosimetry
- Energy and Angular Distribution Information

RADIATION QUANTITIES AND DOSE LIMITATION SYSTEMS

- Exposure
- Absorbed Dose
- Dose Equivalent
- Effective Dose Equivalent (EDE)
- Special Doses
    - Deep Dose
    - Shallow Dose
    - Skin Dose
    - Dose to the Eye
- Committed Dose Quantities
- Collective Dose Quantities
- Summary
- Development of Radiation Limits and Limit Systems
- Regulatory Agencies (Includes Regulatory Publications and Guidance)
- Regulatory Limit Systems and Special Concepts

RADIATION HEALTH EFFECTS

- Type of Radiation Effects
- Mechanisms of Radiation Damage
- Factors Affecting Radiosensitivity
- Acute Radiation Syndrome
- Lower Dose Radiation Effects

EXTERNAL DOSE ESTIMATION: POINT KERNEL APPROACHES

- Point Kernel Approaches
- Flux and Fluence
- Specific Gamma Ray Constant
- Simple Estimations of External Dose (Using Gamma Exposure rate Constant)

- Point Sources
- Line Sources
- Plane Circular Sources
- Cylindrical Sources

INTRODUCTION TO SHIELDING

- Approaches to External Dose Limitation
- Shielding Photons
  - The Point Kernal and Buildup Factor Approach to Shielding Photons
- Shielding Neutrons
  - General Approach
- Shielding Charged Particles
  - Energetic Betas
- Standardized Approaches to Shielding Problems
  - ICRP
  - NCRP
  - US NRC Regulatory Guides
- Difficulties with Shielding
- The Monte Carlo Approach

INTERNAL DOSE ASSESSMENTS: ICRP METHODS, LIMITS AND QUANTITIES

- Basic Internal Dose Problem
- Definitions
- Aspects of the Problem
  - Intake
  - Metabolism (Biodistribution/Retention)
  - Excretion
  - Decay
  - Dose Computation
- ICRP Methods of Dose Limitation
  - Primary Dose Limits
  - ICRP 26, ICRP 60 and 10 CFR 20 Secondary Limits (ALI)
  - ICRP 26, ICRP 60 and 10 CFR 20 Derived Quantities (DAC)
  - NRC Approach to Effluents

INTERNAL DOSE ASSESSMENT: ICRP 30 APPROACH

- ICPR 30 Methodology
- Basic ICRP 30 Approach and Limitations
- Fundamental Equation
- SEE
- ICRP 23
- Decay Data
- Absorbed Fractions
- Disintegrations from Retention Functions
- Disintegrations from Models
- Beyond ICRP 30

RADIATION DETECTOR BASICS

- Basic Approach to Detection
- Types of Detection Systems
- Gas-Filled Detectors
- Scintillation Detectors

- Semiconductor Detectors

GAMMA RAY SPECTROSCOPY

- Motivation for Gamma-Ray Spectroscopy
- Detectors for Spectroscopy
- Features of Measured Spectra

EXTERNAL DOSIMETRY AND DOSIMETERS: PERSONNEL AND PERSONAL

- Definitions
  - Dosimetry
  - Dosimeters
- History of Dosimeter Use
- Personnel Dosimeter Requirements
  - US 10 CFR 20
- Professional Standards and Requirements for Dosimeters
- Dosimeter Demand and Radiation Environments
- Types of Dosimeters
- Proper Dosimeter Badge Usage
  - Badge Placement and Orientation
  - Badging “Special” Individuals
  - Number and Types of Badges
  - Badge Exchange Frequency
  - Badge “hygiene” Issues
- Public (Environmental) External Dose Assessment

ACTIVE DOSIMETERS

- Types of Dosimeters
- Advantages and Disadvantages of Active Dosimeters
- Pocket Ionization Chambers
  - Functioning
  - Advantages and Disadvantages
  - Energy Dependence
  - Adaptation for Neutrons
  - Generalized Performance
  - Examples
- Electronic Dosimeters
  - Types and Functioning
  - Advantages and Disadvantages
  - Generalized Performance
  - Examples of Commercial EPDs
  - Commercial EPD Intercomparison

PASSIVE DOSIMETERS: TLD PHYSICS

- History of TL
- Advantages and Disadvantages of TLDs
- Physics of TLDs
  - Types of Scintillation
  - Types of Luminescence
  - Physics of Thermoluminescence
  - Mechanisms of Thermoluminescence
  - The TL Process
- TL Heating Models

- General Heat Conduction Model
- Simulated Temperature Profiles
  - Comparison to Experiment
  - Focused and Unfocused Laser Heating
  - Effects of TLD Light Self-Absorption
  - Impact of Physical Parameters on Glow Curves

PASSIVE DOSIMETERS: APPLIED TLDS

- TL Glow Curve Production
  - General Observations
  - Multiple Peaks
  - Models of Multiple Peaks
  - Fading
  - Heating Cycles
- TLD Response
  - Variations with Dose
  - TLD Tissue Equivalency
  - Variations with Photon Energy
  - Response to Betas
  - Response to Neutrons
  - Effects Prior TLD Usage
  - Practical Performance
- Different TL Materials and Properties
  - General Properties
  - Lithium Fluoride
  - Calcium Fluoride
  - Calcium Sulfate
  - Lithium Tetraborate
- TLD Glow Curve Analysis

PASSIVE DOSIMETERS PART D: TLD DETECTORS, BADGES, READERS AND OTHER EQUIPMENT

- Overview of TLD Equipment
  - Materials
  - Detector Forms
  - Badges and Badge Holders
  - Readers
  - Accessories
- Examples of Commercial TLD Systems
- TLD (and other) Dosimeter Services

PASSIVE DOSIMETERS PART E: OTHER TYPES OF PASSIVE DOSIMETERS

- Electret Ionization Chambers
- Track Etch Detectors
- Bubble Detectors
- Optically Stimulated Luminescent (OSL) Detectors

CONTINUING EDUCATION CREDITS

The American Academy of Health Physics (AAHP) has awarded this course __ continuing education credits.
Assigned ID Number:

For further information or assistance, please contact:

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