

AEC Radiation Online Course Syllabus

- Module 1: FUNDAMENTALS OF RADIATION – PART 1
 - MODULE 1-1: HISTORY OF RADIATION SCIENCE
 - The Beginning
 - Radiation Science Pioneers
 - Development of Nuclear Technology
 - Need for Radiation Protection
 - MODULE 1-2: RADIATION IN LIFE
 - Sources of Radiation
 - Natural Sources
 - Man-made Sources
 - Categories of Radiation – Ionizing and Non-Ionizing
 - Exposure to Radiation – External vs Internal Irradiation
 - Radiation Dose
- Module 2: FUNDAMENTALS OF RADIATION – PART 2
 - MODULE 2-1: ATOMS AND ELEMENTS
 - Introduction
 - Structure of the Atom
 - Electrons
 - Protons
 - Neutrons
 - Periodic Table of the Elements
 - Chart of the Nuclides
 - MODULE 2-2: NON-IONIZING VS IONIZING RADIATION
 - Introduction
 - Non-ionizing Radiation
 - Ionizing Radiation

- Alpha particles
 - Beta particles
 - Gamma rays
 - X rays
 - Hazards of gamma and X-radiation
 - Neutrons
- MODULE 2-3: NUCLEAR FISSION
 - Introduction
 - Neutrons
- MODULE 2-4: ENERGY OF EMISSIONS
 - Introduction
- MODULE 2-5: SHIELDING
 - Introduction
- Module 3: RADIOACTIVITY AND HALF-LIFE
 - MODULE 3-1: UNITS OF ACTIVITY
 - Introduction
 - MODULE 3-2: ACTIVITY IN OR ON OTHER MATERIALS
 - Introduction
 - Activity Concentration
 - Specific Activity
 - Total Activity
 - Radioactive Contamination
 - MODULE 3-3: HALF-LIFE
 - Introduction
 - Comparative Half-lives
 - Visualizing the Half-life Concept
 - Practical Applications of Half-life
 - MODULE 3-4: USING HALF-LIFE EQUATIONS
 - Introduction

- The Basic Decay Equation
- Solving the Decay Equation for Different Unknowns
 - Solving for Unknown Activity at Some Time
 - Solving for an Unknown Original Activity
 - Solving for an Unknown Elapsed Time
 - Example Problems
- Module 4: RADIATION BIOLOGY AND DOSE
 - MODULE 4-1: IONIZING RADIATION AND EXPOSURE
 - Introduction
 - Ionizing Radiation Review
 - Radiation Fields and Exposure
 - Radiological Definition of Exposure
 - MODULE 4-2: RADIATION ENERGY ABSORBED IN THE HUMAN BODY
 - Introduction
 - Radiation Effects on Human Tissues
 - Energy Deposited in Matter
 - Absorbed Dose
 - Linear Energy Transfer (LET)
 - Quality Factor (Q)
 - Dose Equivalent (H)
 - Shallow Dose Equivalent (SDE)
 - Lens Dose Equivalent (LDE)
 - Deep Dose Equivalent (DDE)
 - Total Effective Dose Equivalent (TEDE)
 - Tissue Sensitivity to Radiation Damage
 - MODULE 4-3: MEASURING DOSE EQUIVALENT
 - Introduction
 - Pocket Ion Chamber
 - Badge Dosimeters

- Film Badges
 - Thermoluminescent Dosimeters (TLDs)
 - Optically Stimulated Luminescence Dosimeters (OSLDs)
 - Electronic Digital Dosimeters
 - Dose and Dose Rate Example Problems
- Module 5: BIOLOGICAL EFFECTS OF RADIATION
 - MODULE 5-1: RADIATION DAMAGE TO CELLS
 - Introduction
 - Damage to DNA within Cells
 - Direct Action
 - Indirect Action
 - Non-stochastic Effects
 - Stochastic Effects
 - MODULE 5-2: DIFFERENCES IN DOSE RATES
 - Introduction
 - Acute Dose Rates
 - Lethal Dose to Fifty Percent of the Population (LD50)
 - Effects of Acute Whole-Body Irradiation
 - Actual Radiation Incidents
 - Fractionated Dose Rates
 - Chronic Dose Rates
- Module 6: RADIATION DAMAGE AND RISK
 - MODULE 6-1: CONSEQUENCES OF RADIATION DAMAGE
 - Introduction
 - Somatic Effects
 - Genetic Effects
 - In-utero Effects
 - Delayed Effects
 - Summary of Effects

- MODULE 6-2: RISKS OF MORTALITY
 - Introduction
 - Cancer Risks
 - Comparative Risks
- MODULE 6-3: THEORETICAL MODELS OF RADIATION RISK
 - Introduction
 - Linear Non-threshold Model
 - Linear Quadratic Model
 - Linear with Threshold Model
 - Supra-linear Model
 - Hormesis Model
 - Spaghetti Plot
 - Summary
- Module 7: KEEPING DOSES ALARA
 - Introduction
 - MODULE 7-1: TIME
 - Introduction
 - Example
 - MODULE 7-2: DISTANCE
 - Introduction
 - Inverse Square Law
 - Examples
 - MODULE 7-3: SHIELDING
 - Introduction
 - Half-value Layer (HVL)
 - Example problem
 - Tenth-value Layer (TVL)
 - Example problem
 - Types of Radiation Shielding

- MODULE 7-4: CONTROLLING ACCESS TO SPECIFIC AREAS
 - Introduction
 - Controlled Area
 - Restricted Area
 - Radiation Area
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- Module 8: PORTABLE RADIATION SURVEY METERS
 - Introduction
 - MODULE 8-1: TYPES OF PORTABLE RADIATION SURVEY METERS
 - Introduction
 - Instruments
 - Ion Chamber Devices
 - Geiger-Mueller (G-M) Detectors
 - Scintillation Detectors
 - MODULE 8-2: READING RESULTS FROM SURVEY METERS
 - Selecting and Reading Scales
 - MODULE 8-3: EFFICIENCY
 - Defining Efficiency
 - Calculating Efficiency
 - Example
 - Example Problems
 - Example Problems Solved
 - Differences in Instrument Response
 - MODULE 8-4: CALIBRATION
 - Introduction
 - Meters Made to Measure Gamma and X-radiation
 - Meters Made to Measure Alpha, Beta, Gamma and X-radiation
 - MODULE 8-5: INSTRUMENT OPERATION

- Introduction
- Approaching a Radiation Source
- Approaching an Unknown Radiation Source

- Module 9: NUCLEAR GAUGES

- Introduction
- MODULE 9-1: GAUGE CONSTRUCTION
 - Source Considerations
 - Radionuclides Used in Gauges
 - Operating Principle
 - Gauge Components
 - Source
 - Detector
 - Evaluation Unit
 - Nuclear Gauge Advantages
 - Examples of Density Gauges in Use
- MODULE 9-2: GAUGES AND ALARA
 - Introduction
 - Gauges and Common Sense
 - Time
 - Distance
 - Shielding
 - Information, Procedures and Handling
 - Instructions / Blueprints / Drawings
 - Shutter Operation
 - General Conditions
 - Gauge Survey
 - Leak Testing
 - Emergencies
 - Confined Space Entry

- Gauge Care and Maintenance
- MODULE 9-3: PORTABLE DENSITY GAUGES
 - Introduction
 - Direct Transmission
 - Backscatter Method
 - Security
- Module 10: REGULATORY CONTROL OF RADIOACTIVITY
 - MODULE 10-1: AUTHORITIES AND DEFINITIONS
 - U.S. Nuclear Regulatory Commission (USNRC)
 - Agreement States
 - Licensing States
 - Licensing of Radioactive Material
 - Sealed Source & Device Registry (SSDR)
 - Radioactive Materials License
 - Inspections
 - Environmental Protection Agency (EPA)
 - Food and Drug Administration (FDA)
 - Occupational Safety and Health Administration (OSHA)
 - MODULE 10-2: ALARA AND DOSE LIMITS
 - The ALARA Concept
 - Radiation Dose Limits
 - Minimum Training
- Module 11: RADIATION PERSONNEL
 - MODULE 11-1: TITLES, DUTIES AND RESPONSIBILITIES
 - Radiation Safety Officer (RSO)
 - RSO Duties and Responsibilities
 - Authorized User (AU)
 - Authorized User Duties and Responsibilities
 - Advanced Authorized User (AAU)

- Advanced Authorized User Duties and Responsibilities
 - Ancillary Personnel
 - Definitions of Use
- MODULE 11-2: RADIATION WORK PERMIT (RWP)
 - Introduction
 - RWP Training
 - Top Block of Information
 - Precautions Block of Information
 - Signature Block of Information
 - Final Check
- Module 12: TRANSPORTING RADIOACTIVE MATERIALS
 - MODULE 12-1: SHIPPING RADIOACTIVE MATERIAL WITHIN THE U.S.
 - Introduction
 - Shipping Radioactive Material Internationally
 - MODULE 12-2: GENERAL LICENSEES
 - Introduction
 - Excepted Quantities
 - USDOT and IATA Definitions
 - Package
 - Transport Index
 - Overpacks
 - Placarding
 - Shipping Paper
 - Bill of Lading
 - Shippers Declaration of Hazardous Goods
 - Shipping Papers – Summary
 - Disposal or Reuse of Radioactive Material
 - Disposal
 - Reuse