RADIATION SPECIALIST MODULES AND OBJECTIVES

Module 1: The Atom and Radioactivity

1. Define the following terms:
    a. Nucleon
    b. Nuclide
    c. Isotope
    d. Radioactivity
    e. Radioactive decay
    f. Fission
    g. Criticality
    h. Fusion
2. Identify how the neutron-to-proton ratio is related to nuclear stability.
3. Identify the basic principles of the mass-energy equivalence concept.
4. Explain why fission products are unstable.

Module 2: Characteristics of Radioactive Decay

1. Explain the characteristics of alpha, beta, and gamma radiations.
2. Define the following terms:
    a. Curie
    b. Becquerel
    c. Specific activity
    d. Half-life

Module 3: The Chart of the Nuclides

1. Using reference documents or computer programs, identify the following for a given nuclide:
    a. Atomic number
    b. Atomic mass
    c. Stability
    d. Half-life
    e. Types and energies of radioactive emissions
2. Given the Chart of Nuclides, trace the decay of a radioactive nuclide and identify the stable end-product

Module 4: Radiation Interactions

1. Define the following terms:
    a. Excitation
    b. Bremsstrahlung
    c. Ionization
2. Explain the concept of Linear Energy Transfer (LET).
3. Explain the methods by which alpha, beta, gamma, and neutron radiation interact with matter.
4. Name examples of materials best suited to shield alpha, beta, gamma, and neutron radiation.

Module 5: Dosimetry Terminology

1. Define the following terms:
    a. Exposure
    b. Roentgen
    c. Absorbed dose
    d. Rad/grav
    e. Quality factor
    f. Dose equivalent
    g. Rem/sievert

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Module 6: Biological Effects

1. Define the following terms and give examples of each:
    a. Stochastic effect
    b. Non-stochastic effect
2. Define the law of Bergonie and Tribondeau.
3. Describe factors that affect the radiosensitivity of cells.
4. Given a list of types of cells, identify which are the most and which are the least radiosensitive.
5. Distinguish between the terms somatic and heritable as they apply to biological effects.
6. Describe the risks of radiation exposure to the developing embryo and fetus.
7. Identify the possible somatic effects of chronic exposure to radiation.

Module 7: Radiation Detector Theory Part 1

1. Given a graph of the gas amplification curve, identify the regions of the curve.
2. Identify the characteristics of a detector operated in each of the useful regions of the gas amplification curve.
3. Describe the methods employed with gas filled detectors to discriminate among various types of radiation and various radiation energies.

Module 8: Radiation Detector Theory Part 2

1. Explain how a scintillation detector and associated components operate to detect and measure radiation.
2. Explain how neutron detectors detect neutrons and provide an electrical signal.
3. Explain the fundamental mechanism by which isotope identification detectors operate and the advantages and disadvantages of the different types of systems available.

Module 9: External Exposure Control

1. Calculate the gamma exposure rate for specific radionuclides using equations or by using a computer program.
2. Using the stay time equation, calculate an individual's remaining allowable dose equivalent, or stay time.
3. Identify "distance to radiation sources" techniques for minimizing personnel external exposures.
4. Using the point source equation (inverse square law), calculate the exposure rate or distance for a point source of radiation.
5. Define the unit of density thickness.
6. Calculate shielding thickness or exposure rates for gamma and X-ray radiation using equations or by using a computer program.

Module 10: Contamination Control

1. Define the terms removable and fixed surface contamination, state the difference between them, and explain the common methods used to measure each.
2. State the basic principles of contamination control and provide examples of implementation methods.
3. State the purpose of using protective clothing in radiologically contaminated areas.
4. Describe the basic factors that determine protective clothing requirements for personnel protection.

Module 11: Transportation of Radioactive Material

1. Identify terminology and acronyms associated with shipments of radioactive material.
2. Describe methods that can be used to determine the radionuclide contents of a package.

3. Identify the types of packages used in the transport of radioactive material and list examples of material shipped in each type of shipping package.
4. Identify the approved placement of placards on a transport vehicle.
5. Describe the radiation and contamination surveys that are performed on radioactive material packages and state the applicable limits.
6. Describe the radiation and contamination surveys that are performed on exclusive-use vehicles and state the applicable limits.
7. Identify the information contained on shipping papers used for transporting radioactive material.

Module 12: Radiological Survey Instruments

1. Describe the following features and specifications for commonly used instruments.
    a. Types of detectors or probes available
    b. Operator-adjustable controls
    c. Specific limitations and characteristics
2. Describe the factors that affect the selection of a portable radiation survey instrument and identify appropriate instruments for external radiation surveys.
3. Identify the following features of and specifications for exposure rate instruments:
    a. Types of detectors available for use
    b. Detector shielding and window
    c. Types of radiation detected and measured
    d. Gamma energy response characteristics
    e. Markings for detector effective center
    f. Specific limitations and characteristics
4. List the factors that affect the selection of a portable contamination monitoring instrument.
5. Describe the following features and specifications for commonly used count rate meter probes:
    a. Types of detectors available for use
    b. Detector shielding and window
    c. Types of radiation detected and measured
    d. Gamma energy response characteristics
    e. Specific limitations and characteristics

Module 13: Acute Radiation Syndrome

1. Explain the three classic syndromes and four stages of the acute radiation syndrome and identify the exposure levels and symptoms associated with each.
2. Describe the LD50/30 value for humans.

Module 14: Internal Exposure Control

1. Describe three factors that govern the behavior of radioactive materials in the body.
2. Explain the two natural mechanisms that reduce the quantity of a radionuclide in the body.
3. Explain the relationship of physical, biological, and effective half-lives.
4. Given the physical and biological half-lives, calculate the effective half-life.
5. Define the term reference man.
6. Define the terms annual limit on intake (ALI) and derived air concentration (DAC).
7. Describe methods used to increase the elimination rate of radioactive materials from the body.

Module 15: Radiological Incidents

1. Describe the general response and responsibilities of a specialist during any radiological incident.
2. Describe the specialist's response to a fire in a radiological area or involving radioactive material.

3. Describe the specialist's response to a radioactive material spill.
4. Describe the specialist's response to personnel contamination.
5. Describe the specialist's response to rapidly increasing or unanticipated radiation levels.
6. Describe the specialist's response to off-scale or lost dosimetry.
7. Identify the available federal responder resources and explain the assistance that each group can provide.

Module 16: Uses and Regulations

1. State some of the common uses of radioactive material.
2. List the applicable agencies that have regulations governing the transport of radioactive material.
3. Define the following terms:
    a. Radiation dispersal device (RDD)
    b. Radiation exposure device (RED)
    c. Improvised nuclear device (IND)

Module 17: Personnel Decontamination

1. Describe how personnel, personal protective equipment, apparatus, and tools become contaminated with radioactive material.
2. State the purpose of radioactive material decontamination.
3. Describe the three factors that determine the actions taken in decontamination of personnel.
4. Describe methods and techniques for performing personnel decontamination.
5. Describe field decontamination techniques for equipment.