

NPRE 247 - Exam 1 Study Guide

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This document is a short summary of main topic listed under "learning objectives" for Prof. Katy Huff's NPRE 247 class.

1 Fundamentals

1. Physical important to nuclear engineering
2. Derive the electron volt
3. Define the atomic mass unit
4. Place neutrons, protons, and electrons within the Standard Model
5. Explain the significance of the A/Z X nomenclature
6. Define nuclide, isotope, isobar, isomer, isotone
7. Calculate relative atomic masses from γ_i atomic abundances
8. Calculate atom density, isotope num. density, and molecule density from combinations of ρ , \mathcal{A} , γ_i , N_A , w_i
9. Estimate the diameter of an atom
10. Identify major sources of energy worldwide and domestically
11. Differentiate between energy and electricity usage.
12. Distinguish among the major modes of energy production.
13. Map the geography of nuclear power production.

2 Modern Physics

1. State the postulates of Special Relativity
2. Differentiate between inertial/non-inertial frames
3. Compare classical and relativistic physics approaches

4. Calculate relativistic masses
5. Calculate time dilation
6. Calculate length contraction
7. Describe the photoelectric effect
8. Calculate Compton scattering angles and kinetic energies
9. Calculate deBroglie wavelengths
10. Relate energy and wavelength for photons
11. Understand wave-particle duality
12. Relate wave-particle duality and particle energy/wavelength

3 Nuclear Models

1. Summarize the history of atomic theory development
2. Recognize the radiation signatures that drove atomic theory
3. List and describe the atomic models
4. List and describe the nuclear models
5. Explain the structure of the chart of the nuclides

4 Energetics

1. Define exothermic and endothermic nuclear reactions
2. Calculate binding energies
3. Notation for binary reactions
4. Physics of common binary reactions
5. Explain the relationship between Q-value, mass, and energy in a reaction
6. Energy and charge conservation in binary reactions
7. Calculate Q-values for various reactions

5 Radioactivity

1. Explain the discovery of radioactivity
2. What causes radioactive decay
3. Sources of manmade and natural radiation
4. Read and understand a decay diagram
5. Describe the various types of decay
6. Derive the radioactive decay law. Also write it in terms of half-lives.
7. Calculate simple decay with production