XRA 111 – FINAL EXAM OUTLINE

SECTION I – Characteristics of X-rays & X-ray Spectrum

Chapters: Week 1–2 (Radiation Basics / Properties of X-rays)
Summary:

- Properties of x-rays (penetration, polyenergetic, travel in straight lines, no mass/charge, invisible)

- Continuous spectrum (Bremsstrahlung)

- Discrete spectrum (Characteristic)

- Beam **quality** vs **quantity/intensity**

- Position of x-rays on EM spectrum

- **X-rays vs Gamma rays** (origins, energy, clinical relevance)

Weight: 10–15%

SECTION II – X-ray Tube & Radiographic Equipment

Chapters: Tube structure & function (Weeks 2–3)
Summary:

- Cathode: filament, thermionic emission, focusing cup

- Anode: target, focal spot, heat production

- Rotor, stator, glass envelope, tube housing

- Primary vs remnant beam

- Factors affecting the focal spot and resolution

Weight: 10–15%

SECTION III – Exposure Factors: Quality & Quantity (Intensity)

Chapters: Technique Chapters (Weeks 4–6)
Summary:

- **kVp** – beam quality, penetration, contrast, patient dose, Photoelectric effect vs Compton

- **mA** – tube current; x-ray **quantity (intensity)**

- **Exposure time** – motion control

- **mAs** – total beam quantity/intensity

- mAs reciprocity (maintaining constant exposure)
- Technique charts: fixed kVp vs variable kVp principles

Weight: 15–20%

SECTION IV – Exposure Indicators, Distance, and Dose Relationships

Chapters: Exposure Concepts (Weeks 6–8)

1. X-ray Quantity = Intensity

- Intensity = number of photons in the beam
- Controlled by mAs; influenced by kVp and SID

2. Distance Laws

Inverse Square Law — intensity changes with distance

- $I_1/I_2 = (D_2^2/D_1^2)$
- Tested conceptually and through simple calculations

Direct Square Law — mAs compensation for SID changes

- $mAs_1/mAs_2 = (D_1^2/D_2^2)$

3. Exposure Indicators (EI, TEI, DI)

- **EI** = actual exposure received by detector
- **TEI** = target/desired exposure index
- **DI (Deviation Index)** = compares EI to TEI

4. DAP (Dose-Area Product)

- Total radiation delivered to patient
- Affected by field size, not SID

5. Collimation Effects

- Less scatter → higher contrast
- With AEC: more collimation → longer exposure time; EI unaffected **if AEC sees enough exposure**

Weight: 15–20%

SECTION V – Radiographic Image Quality

Chapters: Image Formation & Quality (Weeks 8–10)
Summary:

- Brightness vs exposure

- Contrast (kVp-driven; affected by scatter)

- Spatial resolution: focal spot, SID, OID, motion

- Quantum noise (mottle): relationship to EI and exposure

- Window level (brightness) / window width (contrast)

Weight: 20–25%

SECTION VI – 15% Rule, Scatter, Beam Restriction, and Grids

Chapters: Technique Modification & Scatter Control (Weeks 10–12)

15% Rule

- +15% kVp ≈ doubling exposure

- −15% kVp ≈ halving exposure

Scatter Production

- Patient thickness, field size, higher kVp → more scatter

- Scatter decreases contrast

Beam Restriction

- Collimation reduces scatter and patient dose

- Affects AEC behavior

Grids

- Purpose and indications

- Grid ratio, GCF (grid conversion factor), Air Gap Technique (OID)

- Grid cutoff conditions:

  o Off-level, off-center, off-focus, upside-down grid

- Impact on receptor exposure and image quality

Weight: 15–20%

SECTION VII – Automatic Exposure Control (AEC)

Chapters: AEC Operation & Problem Solving (Weeks 12–14)
Summary:

- Ion chambers and how AEC measures exposure

- mA, kVp, SID effects on AEC timing

- Minimum response time

- Backup time/mAs

- Density settings (why they should *not* be used routinely)

- Collimation effects: undercutting chamber, EI changes

- Prosthesis over the chamber → early termination

- Off-centering errors

- Chamber selection based on anatomy

- Image receptor speed (sensitivity)

- Scenario-based problem solving

Weight: 15–20%

Overall Exam Structure

The final exam contains 100 questions and includes all major ARRT-style formats:

- **Multiple choice**
- **Multiple-multiple (select all that apply)**
- **Ordering and sequencing questions**
- **Short calculation items (including inverse square law, direct square law, 15% rule, and EI–related problems)**

The total testing time is 2.5 hours, which equals 150 minutes.