**FINAL EXAM GUIDE — CSE407 Green Computing (Summer 2025)**

This guide replaces the Spring 2025 version. It keeps the universal rules and regenerates all principle‑specific content using **five** principles for this semester: **Cloud Computing, Virtualization, Design for Longevity, Use of Environment‑Friendly Materials, and Green Infrastructure**.

**1) Why this guide?**

The final exam is a **reasoning test**. You will be evaluated on how you **structure**, **justify**, and **connect** ideas—not on rote definition recall. Your answers must read like design decisions for a real system.

**2) Midterm vs Final — what changed?**

| **Feature** | **Midterm Style** | **Final Exam Style** |
| --- | --- | --- |
| Principle use | 1 core + 1 secondary | **3–4 principles** with clear **roles** |
| Structure | Disjoint parts, short notes | **Whole‑system logic**, connected narrative |
| Overlap logic | Optional | **Required** (synergies + conflicts) |
| Role thinking | Static label | **Dynamic**: role must make sense in strategy |
| Answer depth | Point mapping | **Reasoned explanation + justification** |
| Rotation | Not enforced | **No principle repeats the same role** within an answer |

**3) The 4‑Step Formula for a strong answer**

**Step 1 — Break down the system.** Split the problem into **3–4 meaningful parts** (e.g., device layer, user/app layer, backend/infra, policy/risk).

**Step 2 — Assign roles to principles.** Choose **3–4 principles** and give each a **role**:

* **Anchor** — carries the main sustainability outcome.
* **Driver** — links parts; makes the design cohere.
* **Supporter** — strengthens weak spots or risk areas.
* *(Optional)* **Balancer** — resolves a tension or trade‑off.

**Step 3 — Explain overlaps.** For each pair of parts, state whether interactions **align** (reinforce) or **conflict** (trade‑offs) and why.

**Step 4 — Reflect.** Close with **why these roles**, **what worked**, **what trade‑offs remain**, and **what sustainability outcome** you achieved.

**4) The football logic (role chemistry)**

* **Anchor = Striker** (core goal)
* **Driver = Midfielder** (connects everything)
* **Supporter = Defender/Goalkeeper** (protects weak links)  
  A good answer has **chemistry** between roles, not just strong isolated players.

**5) What to study — principle quick guides (this semester’s five)**

Use these **one‑line anchors** to keep each principle crisp in your head. Apply them with roles in context.

**A) Cloud Computing**

* **One‑liner:** Outsource computing to specialized, efficient providers so software and infrastructure run in **optimized, greener** environments.
* **You’ll use it to:** move heavy work off local machines; favor **utility‑style**, scalable backends; simplify user devices.

**B) Virtualization**

* **One‑liner:** **Decouple** software from hardware so multiple services share fewer machines—cutting energy, cooling, and hardware sprawl.
* **You’ll use it to:** consolidate servers; enable dynamic scaling; extend hardware life by improving utilization.

**C) Design for Longevity**

* **One‑liner:** Build and choose systems that **stay useful longer**—durable, repairable, upgradable; resist planned obsolescence.
* **You’ll use it to:** reduce embodied emissions by **fewer replacements**; require modularity and long‑term support.

**D) Use of Environment‑Friendly Materials**

* **One‑liner:** Prefer **non‑toxic, recyclable, responsibly sourced** materials and minimal/green packaging across the device lifecycle.
* **You’ll use it to:** avoid hazardous substances; choose recycled/biobased materials; check supplier take‑back and ethics.

**E) Green Infrastructure**

* **One‑liner:** Design data centers and facility‑level systems as **sustainable architectures**—power/cooling/space planned with environmental goals.
* **You’ll use it to:** align software, hardware, and site design; monitor PCFE (power, cooling, floor space, environment) with proactive scaling.

Memorize the essence; **apply** with roles to concrete subsystems.

**6) What will questions look like?**

Each question will:

1. Describe a real system/context.
2. Ask you to split it into **3+ parts**.
3. Force you to pick **3–4 principles** and **assign roles** (no role repetition).
4. Require **overlap analysis** (synergy/conflict).
5. Expect a **reflection** on trade‑offs and sustainability outcome.

**Format rule:** One small **role map table** is allowed; the rest should be clear paragraphs.

**7) Recommended writing format (hybrid)**

**System Breakdown** — name 3–4 parts with 1‑line purposes.  
**Role Assignment** — table with parts ↔ roles (short).  
**Overlap Logic** — 2–3 short paragraphs on synergies/conflicts.  
**Final Reflection** — why these roles, what trade‑offs, net outcome.

**8) Portion & coverage standards (design requirements)**

* Every answer uses **3–4 principles** from the current set of five.
* **Role rotation:** A principle cannot hold the **same role** twice in the **same answer**.
* **Subsystem coverage:** Each major part must be **explicitly governed** by at least one role.
* **Overlap duty:** Cover **at least two** overlaps; flag **one trade‑off** if present.
* **Justification duty:** Link each role to the **stated behavior** of the subsystem (not generic claims).
* **Evidence duty:** Invoke the principle’s **core mechanism** (e.g., virtualization → consolidation/dynamic allocation; longevity → repair/modularity; cloud → provider efficiency/utility model; materials → nontoxic/recyclable sourcing; green infrastructure → PCFE + architecture, site/monitoring).

**9) Answering standards (how your writing will be judged)**

* **Clarity over lists:** Use brief lists only to set the map; explain in paragraphs.
* **No buzzword stuffing:** Every claim must tie to your system part.
* **Role fit:** Show **why** a principle is Anchor/Driver/Supporter **for this system**, not in general.
* **Local realism:** Consider constraints (power, repair skill, climate, budgets).
* **Conflict honesty:** Name trade‑offs (e.g., cloud region latency vs renewable mix) and show your mitigation.

**10) Final checklist (quick self‑audit)**

* I used **3–4** principles from the **five** for Summer 2025.
* Roles assigned with **no repetition** for the same role.
* System split into **3–4** parts with purposes.
* At least **two overlaps** analyzed (+ one trade‑off if present).
* Reflection explains **why these roles** and the **net sustainability** result.

**11) Demo questions & sample answers (Summer 2025 set)**

Style: reasoning‑driven; one short table per answer; paragraphs for logic.

**Q1 — Rural Telehealth Kit (Clinic + Home Use)**

**Prompt:** Design a low‑power telehealth kit for rural clinics and home follow‑ups. Components: (a) patient sensor pack, (b) clinician tablet app, (c) backend service for triage. Use **3 principles** with roles; show overlaps and trade‑offs.

**System Breakdown:**  
(1) **Sensor Pack** (vitals, intermittent connectivity)  
(2) **Clinician Tablet App** (offline‑first UI)  
(3) **Backend Triage Service** (data intake, alerts)

**Role Map (only table)**

| **Principle** | **Role** |
| --- | --- |
| **Design for Longevity** | **Anchor** |
| **Virtualization** | **Driver** |
| **Use of Environment‑Friendly Materials** | **Supporter** |

**Explanation:**

* **Longevity → Anchor:** Field sensors must survive rough handling and allow **swappable modules/batteries**; long service life cuts replacement cycles.
* **Virtualization → Driver:** The triage backend runs as virtualized services so compute scales with patient load without adding physical servers; resource pooling stabilizes energy.
* **Eco‑Materials → Supporter:** Prefer **non‑toxic housings**, minimal packaging, and vendor take‑back for worn parts.

**Overlaps:**

* *Sensor ↔ Backend:* Virtualized scaling smooths burst uploads; longevity reduces data gaps from device failures (synergy).
* *Tablet ↔ Sensor:* Durable connectors and replaceable cables reduce waste; eco‑materials ensure safer clinics (alignment).
* *Trade‑off:* Virtualized bursts can raise short‑term power draw in the data center; mitigated by auto‑scaling and off‑peak batch processing.

**Reflection:** Roles rotate cleanly; the system lasts longer, scales cleanly, and reduces toxics at the edge.

**Q2 — City Traffic Analytics (Edge Cameras + Cloud)**

**Prompt:** Build a smart traffic system for a dense city. Parts: (a) edge camera network, (b) cloud analytics platform, (c) driver mobile app. Use **4 principles** with roles; analyze overlaps and one conflict.

**System Breakdown:**  
(1) **Edge Cameras** (weather‑exposed units)  
(2) **Cloud Analytics** (city‑scale compute)  
(3) **Driver App** (routing)  
(4) **Ops Console** (city staff)

**Role Map**

| **Principle** | **Role** |
| --- | --- |
| **Green Infrastructure** | **Anchor** |
| **Cloud Computing** | **Driver** |
| **Design for Longevity** | **Supporter** |
| **Virtualization** | **Balancer** |

**Explanation:**

* **Green Infrastructure → Anchor:** Plan PCFE holistically (power, cooling, floor space, environmental safety) and site workloads accordingly.
* **Cloud → Driver:** Use utility‑style, efficient providers to absorb peak loads and reduce local data center buildout.
* **Longevity → Supporter:** Weather‑sealed camera housings, firmware updatability, and modular optics reduce replacements.
* **Virtualization → Balancer:** Pool compute across regions; shift workloads without adding hardware when events spike.

**Overlaps:**

* *Edge ↔ Cloud:* Virtualization plus cloud regions stabilize load and minimize idle capacity (synergy).
* *Cloud ↔ Ops Console:* Green infra monitoring (thermal/power) guides autoscaling policies (alignment).
* *Conflict:* Cloud region with best latency may not have the greenest energy; mitigate via multi‑region policy that prefers greener regions when viable.

**Reflection:** City‑scale efficiency comes from infra‑level design, not just smarter apps.

**Q3 — University Exam Platform (Campus‑wide)**

**Prompt:** Launch a proctoring‑light online exam system. Parts: (a) university backend, (b) student device zone, (c) faculty dashboard. Use **3 principles** with roles; include one materials decision.

**System Breakdown:**  
(1) **Backend** (auth, timing, grading)  
(2) **Student Devices** (BYOD)  
(3) **Faculty Dashboard** (setup, review)

**Role Map**

| **Principle** | **Role** |
| --- | --- |
| **Cloud Computing** | **Anchor** |
| **Virtualization** | **Driver** |
| **Use of Environment‑Friendly Materials** | **Supporter** |

**Explanation:**

* **Cloud → Anchor:** Shifts heavy compute/storage to optimized providers; reduces campus hardware footprint.
* **Virtualization → Driver:** Enables elastic exam bursts and efficient redundancy without duplicating hardware.
* **Eco‑Materials → Supporter:** Procurement preferences for **recyclable peripherals** (keyboards, headsets) and minimal packaging for campus‑owned devices.

**Overlaps:**

* *Backend ↔ Students:* Cloud + virtualization reduce device spec pressure, extending the useful life of student hardware (alignment).
* *Faculty ↔ Backend:* Virtualized sandboxes isolate cheating‑detection tasks without dedicated servers (synergy).
* *Trade‑off:* Cloud egress costs vs regional choice; mitigated by caching and region selection policies.

**Reflection:** Utility backends + pooled compute deliver low‑footprint assessments.

**Q4 — SME Retail Digitization (POS + Inventory + Reports)**

**Prompt:** A small retailer wants to digitize operations with minimal footprint. Parts: (a) point‑of‑sale tablets, (b) inventory service, (c) weekly analytics report. Use **3 principles** with roles.

**System Breakdown:**  
(1) **POS Tablets** (frontline)  
(2) **Inventory Service** (core DB/API)  
(3) **Analytics Job** (weekly batch)

**Role Map**

| **Principle** | **Role** |
| --- | --- |
| **Design for Longevity** | **Anchor** |
| **Cloud Computing** | **Driver** |
| **Green Infrastructure** | **Supporter** |

**Explanation:**

* **Longevity → Anchor:** Choose rugged tablets with replaceable batteries; extend life with OS updates and repair pathways.
* **Cloud → Driver:** Offload DB and auth to cloud SaaS/PaaS; reduce local servers.
* **Green Infrastructure → Supporter:** Batch analytics in off‑peak windows; monitor PCFE impacts; avoid overprovisioning.

**Overlaps:**

* *POS ↔ Inventory:* Cloud reduces downtime and hardware churn; longevity keeps devices usable for years (synergy).
* *Inventory ↔ Analytics:* Off‑peak batch lowers cooling/power stress (alignment).
* *Trade‑off:* Older tablets may struggle with heavy UIs—design lightweight clients.

**Reflection:** Fewer devices, longer life, smarter hosting.

**12) Common mistakes to avoid**

* Treating principles as **labels** instead of **mechanisms**.
* Repeating the **same role** for a principle in the same answer.
* Writing lists with no **overlap analysis**.
* Ignoring **local constraints** (power, climate, repairability).
* Claiming outcomes without tying them to **PCFE, consolidation, lifecycle, or materials** logic.

**13) Last words**

Think like a **designer**, argue like a **strategist**. Apply the five principles as tools—not slogans. Keep roles tight, overlaps honest, and reflections concrete.