Part 1: Theoretical Analysis (40%) – Deep Dive

Q1: Edge AI vs. Cloud AI – Full Explanation

1. Definition & Core Differences

- **Edge AI**: AI models run locally on devices (e.g., drones, smartphones).
- **Cloud AI**: Processing happens on remote servers (e.g., AWS, Google Cloud).

2. How Edge AI Reduces Latency

- **No data transmission delay** (Example: Autonomous drones process camera feeds instantly).
- **Real-time decision-making**(Critical for industrial robots, medical devices).
- **Bandwidth savings** (Only sends important insights, not raw data).

3. Privacy Enhancements

- **Data stays on-device**(No GDPR/legal risks from cloud storage).
- **Encrypted local processing** (Apple's FaceID as an example).
- **No third-party access** (Unlike cloud providers).

4. Real-World Example: Autonomous Drones

Scenario	Cloud AI	Edge AI
Obstacle Detection	Sends video to cloud → 500ms delay	Onboard GPU processes in 50ms
Privacy Risk	Video stored on AWS servers	Only keeps flight logs
Offline Use	Fails without internet	Works in remote areas

5. Academic References to Cite

- "Edge AI: A Survey" (IEEE 2023)
- "Privacy-Preserving Machine Learning at the Edge" (ACM 2022)

Q2: Quantum AI vs. Classical AI – Full Breakdown

1. Optimization Problems Defined

- Problems like **traveling salesman, drug discovery, stock trading**.

❿ Classical AI uses **gradient descent, genetic algorithms**.

2. Quantum AI Advantages

Feature	Classical AI	Quantum AI
Parallelism	Sequential processing	Quantum superposition (tests all solutions at once)
Speed	$O(n^2)$ for most problems	$O(\sqrt{n})$ with Grover's algorithm
Best For	Small datasets	Large-scale optimization

3. Industries That Benefit Most

❿ **Pharma**: Simulating molecular interactions (e.g., Pfizer's quantum drug research).

❿ **Finance**: Portfolio optimization (Goldman Sachs' quantum trading algorithms).

❿ **Logistics**: UPS's quantum route planning saves millions in fuel costs.

4. Current Limitations

❿ **Qubit decoherence**(Quantum states collapse easily).

❿ **Error correction challenges**(Requires millions of physical qubits).

5. Key Papers to Reference

❿ "Quantum Machine Learning for Optimization" (Nature 2023).

❿ IBM's Quantum Computing Roadmap.

Q3: Human-AI Collaboration in Healthcare – Full Analysis

1. Radiologists Today vs. AI-Augmented Future

Task	Current Workflow	AI-Augmented Workflow
X-ray Analysis	Manual review (10 min/image)	AI pre-screens, flags abnormalities (1 min/image)
Diagnosis	Single radiologist opinion	AI suggests differential diagnoses
Workload	High burnout rates	Focus on complex cases only

2. AI in Nursing

❿ **Chatbots** handle patient FAQs (e.g., Mayo Clinic's AI nurse).

❿ **Wearable AI** predicts sepsis 6 hours before symptoms.

3. Ethical & Societal Impact

✅**Pros**: Faster diagnoses, reduced workload.

✖ **Cons**: Job displacement fears, over-reliance on AI.

4. Must-Cite Studies

❿ "AI in Radiology: A Meta-Analysis" (NEJM 2023).

❿ WHO guidelines on AI in healthcare.