**Functional Requirements (FR)**

**1. User Roles**

* **FR1**: The system shall support two roles:
* **Admin/Invigilator**: Create/manage exam sessions, validate enrollments, upload class lists, view reports.
* **Student**: Pre-enroll with documents/biometrics, authenticate before exams.

**2. Pre-Enrollment**

* **FR2**: Students shall upload scanned copies of:
* Form B (registered courses).
* ID card (school/NIC).
* Fee receipt (proof of payment).
* **FR3**: Students shall enroll their **biometric data** (modality-agnostic) via a physical kiosk.
* **FR4**: Admins shall manually approve/reject enrollments after verifying document validity.

**3. Class List & CA Marks Management**

* **FR5**: Admins shall upload **class lists** (CSV/Excel) for each course, including:
* Student IDs (matriculation numbers).
* **CA marks**.
* **FR6**: The system shall link CA marks to student enrollments (via student matriculation number).

**4. Exam Session Management**

* **FR7**: Admins shall create **authentication sessions** for:
* **Faculty/school**
* Department,
* Level,
* Course (e.g., "COME6101: Advanced Algorithms").
* Date/time window (e.g., 8:00 AM – 10:00 AM, 20 Nov 2024).
* Venue (e.g., "NAHPI Hall A").
* **FR8**: The system shall auto-generate a list of enrolled students for the course (from Form B and class list data).

**5. Authentication Workflow**

* **FR9**: During authentication, students shall:

1. Provide biometric data (e.g., fingerprint scan).
2. Receive real-time validation of:  
   * Biometric match.
   * Document validity (Form B, fee receipt).
   * CA mark eligibility (CA > 0 or "Eligible" status).

* **FR10**: The system shall display:
* Student name, ID (matriculation number), photo.
* Course eligibility status.
* CA mark (if available).
* **FR11**: Grant/deny access based on:
* Valid biometric match.
* Approved documents.
* CA mark eligibility.

**6. Reporting**

* **FR12**: Admins shall view/download:
* Real-time list of authenticated students (with CA marks).
* List of "Question Marked" students with reasons (e.g., "CA Missing", "Fee Unpaid").
* Final attendance report (PDF/Excel).

**7. Data Management**

* **FR13**: The system shall operate **offline** (no dependency on central university DB).
* **FR14**: Store data locally (students, enrollments, CA marks, sessions, logs).

**Non-Functional Requirements (NFR)**

**1. Performance**

* **NFR1**: Authentication response time ≤ 3 seconds per student.
* **NFR2**: Support **50+ concurrent authentications** (scalable to 500+ with optimizations).

**2. Security**

* **NFR3**: Biometric templates (not raw data) stored with **AES-256 encryption**.
* **NFR4**: Student documents and CA marks secured with **role-based access control** (admins only).

**3. Usability**

* **NFR5**: Admin interface requires ≤ 30 minutes of training (simple CSV uploads, intuitive dashboards).
* **NFR6**: Authentication kiosk has a 3-step interface (e.g., "Scan → Verify → Result").

**4. Scalability**

* **NFR7**: Modular design to scale from **1 department (NAHPI)** to the entire university (15k+ students).
* **NFR8**: Database indexing for fast queries (e.g., student ID, course code).

**5. Reliability**

* **NFR9**: System uptime ≥ 95% during exam sessions.
* **NFR10**: Daily backups of critical data (enrollments, CA marks, logs).

**6. Cost**

* **NFR11**: Total hardware/software cost ≤ $200 (MVP phase).
* Example: Refurbished laptop ($150) + fingerprint scanner ($50).

**7. Interoperability**

* **NFR12**: Support common file formats:
* Documents: PDF, JPG, PNG.
* Class lists: CSV, Excel.

**Out-of-Scope (For Future Iterations)**

1. Integration with the university’s central database.
2. Automated CA mark generation (admins will upload manually).
3. Multi-modal biometrics (e.g., fingerprint + facial recognition).
4. Mobile app support for students/admins.

**Key Use Case Example**

**Scenario**: A student attempts to authenticate for the "CE500: Advanced Algorithms" exam.

1. Scans fingerprint at the kiosk.
2. System checks:

* Biometric match → Confirms identity.
* Form B → Registered for CE500.
* Fee receipt → Paid.
* CA mark → 25/30 (eligible).

1. Result:

✅ Authenticated

Name: John Doe

ID: S001

Course: CE500

CA Mark: 25/30