Here's the complete and precise prompt instructing AI to generate the missing features for your Advanced Pilot Training Platform frontend. This ensures that all required functionalities are fully developed and seamlessly integrated into your Lovable.dev-based Next.js frontend.

---

Advanced Pilot Training Platform - AI Code Generation Prompt

Objective:

Develop the missing features and enhancements for the Advanced Pilot Training Platform, a next-generation training system designed for pilot education. The frontend is built using Lovable.dev, Next.js, TypeScript, Tailwind CSS, and shadcn/ui. It integrates real-time collaboration, AI-powered assessments, document management, analytics, and immersive training tools. The AI should ensure a clean, modular, scalable, and production-ready codebase with robust API integrations and offline capabilities.

---

Repository Structure (Modify for Lovable’s Best Practices)

/advanced-pilot-training-platform

/frontend

/components Reusable UI components (buttons, forms, modals, charts, widgets)

/pages Core pages (dashboard, syllabus, assessments, analytics, etc.)

/hooks Custom React hooks (data fetching, UI state, real-time updates)

/services API services for backend integration (auth, syllabus, analytics)

/styles Tailwind CSS styles, shadcn/ui themes, dark mode settings

/assets Static assets (icons, AR/3D models, UI images)

/visualizations 3D/AR components (Three.js, D3.js, interactive dashboards)

/collaboration UI for real-time collaboration, co-editing, presence indicators

/compliance Regulatory validation UI, audit logs, version control tracking

/testing Unit and E2E test suites (Jest, Cypress)

/utils Helper functions, validation schemas (Yup, Zod)

/config API keys, feature flags, environment settings

```

Features to Implement

1. Authentication System Enhancements

- Implement Role-Based Access Control (RBAC) with different user roles (Trainee, Instructor, Admin).

- Add OAuth integration (Google, Microsoft) for simplified login.

- Implement session timeout with auto re-authentication for security compliance.

2. Syllabus Builder Enhancements

- Develop AI-assisted syllabus suggestions based on previous training data.

- Implement regulatory compliance checks (FAA, EASA validation indicators).

- Enable offline mode support (store syllabus edits locally & sync when reconnected).

- Improve real-time collaboration features (live co-editing with better user presence indicators).

- Implement import/export syllabus templates (support JSON, PDF, XML formats).

3. Collaboration & Communication

- Develop role-based commenting & feedback system for syllabus and documents.

- Add live chat & voice notes for instructor-trainee collaboration.

- Implement auto-transcription for training discussions (speech-to-text integration).

- Create meeting scheduling & AI-powered summaries for discussions.

4. Document Management & AI Processing

- Integrate OCR-based text extraction for document compliance tagging.

- Implement AI-powered document classification (auto-sort documents into training modules).

- Develop batch document uploads & approval workflows for efficiency.

- Create version comparison UI (highlight differences between document versions).

- Enable offline document caching & synchronization for remote training.

5. Assessments & Training Reports

- Implement a competency-based grading system with predefined rubrics.

- Develop AI-driven performance insights & trend analysis for instructors.

- Integrate biometric tracking (EEG, eye-tracking) for cognitive assessment.

- Enable speech-to-text feedback input for assessments.

- Support offline assessment mode (auto-sync scores when back online).

6. Analytics Dashboard & KPIs

- Develop customizable dashboard widgets (allow users to create personalized views).

- Implement 3D heatmaps & performance trend analysis for pilot training efficiency.

- Integrate AI-driven predictive analytics (estimate trainee success rates).

- Add export options for reports (PDF, Excel, JSON).

- Develop drill-down analytics for individual and group trainees.

7. Immersive Training (AR/3D)

- Implement real-time cockpit simulation overlays for interactive learning.

- Add WebXR integration for immersive AR training sessions.

- Create AI-generated interactive training exercises with adaptive difficulty levels.

8. Compliance Tracking & Regulatory Validation

- Develop real-time FAA/EASA rule validation for training content.

- Implement automated compliance tracking dashboards for training records.

- Create audit logs & version-controlled compliance reports.

- Generate role-based compliance reports for regulatory inspections.

9. Progressive Web App (PWA) Features

- Develop full offline mode for syllabus editing, assessments, and document viewing.

- Implement background sync for pending uploads & offline submissions.

- Add push notifications for training updates and assessment deadlines.

10. Performance, Testing & Deployment

- Optimize performance with lazy loading, SSR (Server-Side Rendering), and caching strategies.

- Develop CI/CD pipeline with GitHub Actions for automated builds, testing, and deployment.

- Ensure full test coverage with Jest (unit tests) and Cypress (E2E tests).

Final Requirements:

The AI-generated code must be:

* Fully structured and modular, adhering to Lovable’s best practices.
* Optimized for performance, with SSR, caching, and lazy loading.
* Tested and deployable, ensuring all new features are fully functional.
* Production-ready, with well-documented code and a clean repository.

**1. Authentication System Enhancements**

✅ **Objective:** Secure and scalable authentication system with role-based access.  
✅ **Instructions:**

* Implement **Role-Based Access Control (RBAC)** with the following roles:
  + **Trainees:** Access training materials, assessments, and reports.
  + **Instructors:** Manage syllabus, conduct assessments, view analytics.
  + **Administrators:** Oversee system settings, compliance tracking, and user management.
* **OAuth Integration**: Enable login with Google and Microsoft accounts.
* **Auto-session timeout:** Implement inactivity detection → Auto-logout → Redirect to login.
* **JWT Management:** Secure API requests, refresh tokens, and re-authentication flows.
* **User Profile Management:** Allow trainees/instructors to update names, avatars, and preferences.

✅ **Expected Repository Updates:**

* Update /services/auth.ts for RBAC, JWT refresh, and OAuth.
* Modify /components/AuthForm.tsx to support Google/Microsoft login.
* Extend /pages/login.tsx and /pages/signup.tsx for user roles selection.
* Implement **middleware** for protected routes in Next.js.

**2. Syllabus Builder Enhancements**

✅ **Objective:** AI-powered syllabus creation with compliance checks and real-time updates.  
✅ **Instructions:**

* **AI-Assisted Syllabus Suggestions:**
  + Use **pre-existing training data** to suggest module structures.
  + Implement **drag-and-drop AI recommendations** (suggest next lessons).
* **Regulatory Compliance Validation:**
  + Add **FAA/EASA rule-matching indicators** (valid/invalid lesson flags).
  + Display warnings if a syllabus module doesn’t meet compliance.
* **Offline Mode:**
  + Store **syllabus edits in IndexedDB** for offline editing.
  + Auto-sync updates when back online.
* **Live Collaboration:**
  + Show **who’s editing what** in real-time (co-editing presence indicators).
  + Implement **real-time autosave** to prevent data loss.

✅ **Expected Repository Updates:**

* Modify /components/SyllabusBuilder.tsx for AI-based suggestions.
* Extend /services/compliance.ts to validate syllabus content.
* Add /hooks/useOfflineSync.ts for offline storage & auto-sync.
* Update /collaboration/LiveStatus.tsx for multi-user presence indicators.

**3. Collaboration & Communication Features**

✅ **Objective:** Enable instructor-trainee communication via chat, voice notes, and meetings.  
✅ **Instructions:**

* **Role-Based Commenting & Feedback:**
  + Instructors can leave **comments on syllabus, documents, and assessments**.
  + Trainees can respond, ask questions, and request clarifications.
* **Live Chat & Voice Notes:**
  + Implement **WebSocket-based chat module** (with Lovable’s real-time features).
  + Enable **voice recording and playback** for instructors.
* **Auto-Transcription of Discussions:**
  + Convert **voice notes to text** using AI-based speech-to-text.
  + Store transcriptions alongside syllabus and assessments.
* **Meeting Scheduling & AI Summaries:**
  + Integrate **Google Calendar API** for meeting scheduling.
  + Provide **AI-generated summaries** after discussions.

✅ **Expected Repository Updates:**

* Create /components/Chat.tsx for WebSocket-based live chat.
* Add /services/transcription.ts for voice-to-text integration.
* Modify /collaboration/Comments.tsx to support role-based comments.
* Extend /hooks/useMeetingScheduler.ts for Google Calendar integration.

## 4. Document Management & AI Processing

✅ **Objective:** AI-powered document handling, version control, and offline sync.  
✅ **Instructions:**

* **OCR-Based Text Extraction:**
  + Extract **text from uploaded documents** for better searchability.
  + Display **processed text alongside uploaded PDFs/images**.
* **AI-Powered Document Classification:**
  + Auto-sort documents into **Syllabus, Assessments, or Compliance** categories.
* **Version Comparison UI:**
  + Show **differences between document versions** with highlights.
* **Batch Uploads & Approval Workflow:**
  + Allow instructors to **upload multiple files at once**.
  + Implement **document approval system** for admin verification.
* **Offline Caching & Sync:**
  + Store **documents locally** when offline & auto-sync when online.

✅ **Expected Repository Updates:**

* Update /components/DocumentUploader.tsx for batch uploads & OCR processing.
* Modify /services/documentAI.ts for AI classification & version control.
* Add /pages/documents.tsx for document listing, approvals, and comparisons.

**5. Assessments & Training Reports**

✅ **Objective:** AI-powered grading, biometric tracking, and performance insights.  
✅ **Instructions:**

* **Competency-Based Grading Matrix:**
  + Implement a **grading system with 1–4 scale** based on predefined rubrics.
* **AI-Driven Performance Insights:**
  + Use **AI to predict pilot training success** based on assessment history.
* **Biometric Tracking for Cognitive Assessment:**
  + Integrate **EEG & eye-tracking data overlays** for training analysis.
* **Speech-to-Text Feedback Input:**
  + Allow **instructors to dictate verbal feedback** (convert speech to text).

✅ **Expected Repository Updates:**

* Modify /components/AssessmentForm.tsx for competency-based grading.
* Extend /services/biometrics.ts for EEG & eye-tracking overlays.
* Add /pages/assessments.tsx for assessment submission & reports.

**6. Real-Time Analytics Dashboard**

✅ **Objective:** Visual training insights with AI-powered reports.  
✅ **Instructions:**

* **Customizable Dashboard Widgets:**
  + Users can **create personalized views** of training data.
* **3D Heatmaps & Trend Analysis:**
  + Show **performance trends over time** with **interactive heatmaps**.
* **Predictive Analytics:**
  + Use **AI models to estimate training success rates**.
* **Export Reports (PDF, Excel, JSON):**
  + Generate **compliance and assessment reports** in multiple formats.

✅ **Expected Repository Updates:**

* Create /components/Dashboard.tsx for KPI visualization.
* Add /services/analytics.ts for AI-driven insights.
* Extend /pages/analytics.tsx for interactive reporting.