**System Design: AI-Powered Exam Practice and Analysis for AS Level Computer Science**

**1. Introduction**

This system aims to provide students with an online study platform where they can take mock exams, practice specific knowledge points, and receive real-time feedback and performance analysis. The system will allow students and teachers to import past exam papers, categorize questions based on syllabus topics, and provide personalized learning recommendations.

**2. Target Users**

• **Students**: Take mock exams, practice topic-based questions, track progress, and receive insights.

• **Teachers**: Upload and verify exam papers, review student performance, and provide study recommendations.

**3. Core Features**

**3.1 Exam Paper Management**

**3.1.1 Exam Paper Import**

• **Supported Formats**: Image files (JPG, PNG, PDF) and documents (DOCX, PDF).

• **OCR Processing**: AI extracts question text, scores, and answer options.

• **Teacher Verification**: Student-uploaded papers require teacher approval before entering the question bank.

• **Topic Matching**: The system automatically maps questions to relevant syllabus topics.

**3.1.2 Exam Paper Organization**

• **By Year** (e.g., “June 2018”).

• **By Subject** (e.g., “AS Level Computer Science H046/01”).

• **By Topic** (questions categorized according to the syllabus).

**3.2 Question Analysis**

**3.2.1 Knowledge Point Matching**

• The system automatically assigns each question to relevant syllabus topics.

• Example:

• **Question**: What is the function of the ALU in a CPU?

• **Mapped Topic**: Processor Components – ALU Functions.

**3.2.2 Automatic Scoring**

• **Objective Questions**: Multiple-choice and true/false questions are automatically graded.

• **Subjective Questions**: Teachers manually grade and provide feedback.

• **Score Summary**: Displays total score and individual topic performance.

**3.3 Student Exam & Analysis**

**3.3.1 Mock Exams**

• Students can choose:

• **Full Mock Exam** (select from past papers).

• **Topic-Based Exam** (questions selected from a specific topic).

• Timed exam mode.

• Automated grading and instant feedback.

**3.3.2 Performance Analysis**

• **Overall Performance**:

• Total score & percentage (e.g., “47%”).

• Pass/fail status.

• **Knowledge Point Breakdown**:

• Scores by topic (e.g., “Processor Components: 60%”).

• Ranking of strongest and weakest knowledge points.

• Suggested topics for improvement (high error rate topics).

• **Progress Tracking**:

• Comparison with previous exams (improvement or decline).

• Repeated mistakes in past exams.

• Practice frequency vs. error rate insights.

**3.4 Knowledge-Based Practice**

**3.4.1 Practice Modes**

• Students select a topic, and the system generates practice questions.

• Practice modes:

• **Fixed Question Count** (students choose the number of questions).

• **Unlimited Practice** (continuous question mode).

**3.4.2 Practice Feedback**

• After completing a practice session:

• Score for the session.

• Historical performance on the topic.

• Recommended revision areas.

**3.5 Progress Tracking**

• Tracks every mock exam and practice session.

• Generates **long-term learning trends**:

• **Knowledge Mastery Progress** (which topics are improving or declining).

• **Practice Frequency Analysis** (topics practiced less but with a high error rate).

**3.6 Teacher Dashboard**

• **Student Performance Insights**: View exam scores and progress of individual students.

• **Class Analysis**: Identify common weak points across students.

• **Question Bank Management**: Review and approve new exam papers, categorize questions.

**4. System Architecture**

**4.1 Frontend**

• **React.js + Tailwind CSS**: Modern and responsive UI.

• **WebSocket**: Real-time exam timer and results display.

**4.2 Backend**

• **Node.js + Express**: Manages API requests.

• **Python OCR (Tesseract/OpenAI Vision API)**: Converts images and PDFs into structured question data.

• **AI NLP Models (GPT-4, BERT)**: Automatically categorizes exam questions by topic.

**4.3 Database**

• **MySQL**: Stores structured data (users, exams, scores).

• **MongoDB**: Stores unstructured data (exam papers, parsed OCR results).

• **Redis**: Caches frequently accessed data for faster performance.

**5. Future Enhancements**

• **AI-Powered Personalized Learning**: Suggests questions based on student weaknesses.

• **Smart Mistake Tracking**: Students can bookmark incorrect questions for review.

• **Automated Exam Paper Generation**: AI creates new mock tests based on past questions and syllabus.