National University of Computer and Emerging Sciences

Intelligent Outcome Based Education System

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Abstract

In every facet of human existence, the late 20th and early 21st centuries have seen enormous breakthroughs. While these developments have provided students with a wealth of opportunities, they have also made pupils more competitive. Moving from traditional education to skill-based education was now truly important. A student-centered approach to education called outcome-based education (OBE) emphasizes quantifiable learning outcomes as the main way to assess student development. The main goal of this project is to provide instructors and institution management with tools for leveraging course learning outcomes (CLOs) and related program learning outcomes (PLOs) to monitor students' development. OBE is now widely accepted across many countries and has been shown to be effective in supporting students in attaining the skills and information necessary to thrive in the twenty-first century. Also, organizations that accredit educational programs, such NCEAC, NBEAC, PEC, and others, evaluate them based on OBE.

Executive Summary

A method of teaching called outcome-based education (OBE) places more emphasis on the accomplishments of students than on the actual learning process. It requires articulating clearly what students should know, be able to accomplish, or demonstrate at the end of a course or degree, and then integrating teaching, learning, and assessment processes to ensure that those objectives are accomplished. OBE places a strong emphasis on the value of quantifiable learning goals, student-centered teaching strategies, and ongoing evaluation and feedback to enhance student learning. It has been widely used in many areas of education, from basic to higher education, and it has been proven to be successful in enhancing student learning outcomes and preparing students for problems in the real world.

As the methodology of teaching is now shifting from traditional education to outcome-based education, a system is necessary that can handle, automate, and help the instructors and teachers in evaluating the progress of their students. Regarding that, a system is being designed and made which is simple to use yet powerful enough to fulfil all of the demand related to outcome-based education.

Our team has considered every single detail while planning for this system. These details include the flexibility of the system which can empower its user to perform all the tasks hassle-free. The major tasks that can be performed with our system include uploading of all the resources regarding the degree which include courses, CLOs and PLOs, generated progress sheets and report cards to check the results and performing future and effort prediction using Machine Learning techniques to assist the students in improving their academic output.

The Intelligent Outcome-Based Education System is being constructed for the betterment of education and academia so that the students can excel in their studies and the society can flourish as a whole.

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Chapter 1: Introduction

Are you disillusioned with the conventional educational system, which emphasizes memorization above practical skills? Imagine a classroom where the focus is on learning the skills and knowledge necessary to thrive in the real world rather than on attendance or grades. This is the goal of outcome-based education (OBE), a cutting-edge strategy that is revolutionizing the way education is delivered.

A reliance on lectures, memorization, and standardized testing are often characteristics of the traditional educational system. Success in this system is determined by attendance, grades, and test results, and students are frequently seen as passive consumers of information. The traditional educational system frequently lacks a distinct emphasis on the information and abilities that students require to thrive in their chosen careers or in their lives outside of the classroom. Instead of emphasizing the development of specific skills and competencies, the system frequently places more emphasis on the completion of a set number of courses or the accumulation of a certain number of credits. The industry now is more attracted towards the skilled rather than the high achievers and due to this it is necessary to teach the students what is required of them.

The knowledge and skills that students should possess after finishing a course or program are characterized as outcomes for learning in an OBE system. These results are frequently associated with industry or professional standards and are usually quantitative, specified, and attainable. An intelligent Outcome-Based System is an open-source platform that will help instructors manage and monitor their pupils based on the outcomes they produce. Students are given explicit and detailed learning objectives via the OBE system, which helps them comprehend what they must accomplish and how their progress will be evaluated. The Intelligent OBE system will use **artificial intelligence** to do the future assessment of students based on current evaluations. If a student is lagging, alerts will be generated, and an estimate will be made by seeing his/her progress so far if he/she could accomplish the PLO in future or if he/she needs to repeat a course to clear the deficiency. The goal of the project is to help instructors and program management track students' progress using relevant program learning outcomes (PLOs) and course learning outcomes (CLOs). OBE has gained widespread acceptance in numerous nations and has been proven to be efficient in assisting students in acquiring the knowledge and abilities required to flourish in the 21st century. Moreover, accreditation bodies such as NCEAC, NBEAC, PEC and others are evaluating educational programs under their preview based on OBE.

This document primarily covers how the system works and the concepts that were employed in its development. The work done in this scope is explained in the following chapters. Chapter 2 covers the product scope and sustainable development goal (SDG). Chapter 3 covers the literature review which means the work that has already been done before. Furthermore, in Chapter 4, all our system's requirements specifications, both functional and non-functional are described, as well as the use cases, risk analysis, ER diagram, and most importantly graphical user interface (GUI) is also presented in this chapter.

1.1 Purpose of this Document

This document's goal is to give a thorough account of the OBE system's evolution. The vision behind the OBE system development and the high-level functionalities of the OBE system are explained. The document also consists of diagrams and graphical representation to explain the working of the system in an efficient and effective manner. The readers can get a thorough understanding of the system and how it is mapping with the outcome-based education goals.

The documentation shows how the OBE system fills the gap created by the traditional learning environment between the industry requirements and curriculum. Specify the purpose of this Project.

1.2 Intended Audience

Academia Audience: The intended audience for this document includes administration, instructors, and students at the educational institutes.

1.3 Definitions, Acronyms, and Abbreviations

The following is a list of all key terminologies, acronyms, and abbreviations used in this document:

SDG: Sustainable Development Goal

NCEAC: National Computing Education Accreditation Council

CLO: Course Learning Outcome

PLO: Program Learning Outcome

OBE: Outcome-Based Education

ML: Machine Learning

ER Diagram: Entity-Relationship Diagram

PEC: Pakistan Engineering Council

NBEAC: National Business Education Accreditation Council

Chapter 2: Project Vision

This chapter briefly describes the project vision and its objectives. It is divided into multiple subsections such as problem domain overview, problem statement, and elaboration. This chapter also defines the goals and objectives as well as the scope of the project. It also identifies the stakeholders defined for the project and their roles according to their related interests.

2.1 Problem Domain Overview

The Outcome Based Education system is a web-based software program that is intended to assist educational institutions in achieving their OBE objectives. The system is specifically designed to link Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs), ensuring that students are achieving the required goals. This system's main objective is to provide a user-friendly interface to faculty members to organize and oversee the curriculum in accordance with the targeted learning goals and to manage and monitor student progress in reaching the intended learning outcomes. Data analysis on student performance and program outcomes will be done by the system and it will offer insights by employing various graphics. Artificial Intelligence will be used to do the future assessment of students based on current evaluations. Administrators will be able to manage user accounts, roles, and permissions through the system's user management module and they will be permitted to include new PLOs and to change the mapping of CLOs with PLOs of a specific course. Depending on their duties, faculty members will have varying roles and permissions.

2.2 Problem Statement

Many educational institutions struggle to align their curriculum with the desired learning goals, producing students who are insufficiently equipped for the demands of the real world. An outcome-based education (OBE) method that connects program learning outcomes (PLOs) and course learning outcomes (CLOs) can be used to address this issue. Yet, it can be difficult, time-consuming, and subjective to evaluate student performance in relation to the targeted learning objectives. There is a need for a web-based OBE system because there isn't an efficient and effective system for managing the curriculum and assessing student learning outcomes.

2.3 Problem Elaboration

Without a clear grasp of the targeted learning outcomes, the traditional approach to education frequently concentrates on the delivery of course material. This strategy leads to a mismatch between the curriculum and the targeted learning outcomes, leaving students unprepared for challenges in the real world. A significant issue in higher education institutions is the misalignment of the curriculum with the targeted learning goals. Implementing an Outcome-Based Education (OBE) approach can address this issue. This method aids with the development of the knowledge, abilities, and attitudes needed for success in the real world.

The assessment process frequently lacks transparency as well as accountability, which can be a serious drawback of the conventional educational model. Lack of feedback and follow-up on student performance relative to the desired learning outcomes might prevent both students and institutions from making progress and growing. The OBE system addresses this issue by allowing teachers to monitor the performance of a student and providing necessary feedback and counseling on time.

Furthermore, a major obstacle to the introduction of OBE in higher education institutions may be the absence of a reliable system for managing the curriculum and evaluating student learning outcomes. Without a dependable and user-friendly system to support the process, faculty members could be reluctant to devote the time and effort needed to implement OBE.

The system will be scalable and able to accommodate future changes in PLOs or the addition of new programs. The administration will be able to modify or add new PLOs using the system as needed. The system will be easy to understand and use, it will automatically calculate percentages using mathematical formulas when the teacher inputs the assessment data for the students. The system will also display the results graphically using graphs that will make it easy to understand.

2.4 Goals and Objectives

The goal and objectives of the OBE system are as follows:

- To introduce outcome-based education (OBE) in institutions of higher learning.
- To evaluate the effectiveness of the system in achieving the goals of OBE and making the assessment process more efficient and accurate.
- Teachers will be able to create reports on student performance using the system, which will include competency levels, areas of strength and weakness, and overall growth.
- To develop a web-based system that allows the administrator to create, manage, update learning outcomes for various courses using this system.
- To ensure the system is scalable and can accommodate future changes in PLOs or the addition of new programs.
- To provide pictorial representation of student’s assessment results using graphs.
- To employ Artificial Intelligence to do the future assessment of students based on current evaluations of the student.
- Making students aware of what is expected of them and enlightening them about the real-world challenges.

2.5 Project Scope

Teachers and students are the focus for this project. As it is said by the National Computing Education Accreditation Council (NCEAC) that all computing programs should move towards Outcome-Based education soon, it is a good opportunity to develop an OBE system which can be used commercially. The scope of our project will include everything required by the instructors to track the learning progress of the students. This will include different modules. The first module is the data acceptance module that will get the data of a particular department, their courses, CLOs and PLOs, CLO-PLO mapping and their enrolled students. The second module will track the students’ progress and will let the instructor know about the students and their CLOs and PLOs completion. The system will let the teacher know if a student is lagging in any CLO or PLO and needs more attention. The third module will be for administration for creating, managing and updating learning outcomes for various courses using this system. The fourth module will be for the teacher, the teachers will be able to create reports on student performance using the system, which will include competency levels, areas of strength and weakness, and overall growth. The last module will generate all the progress reports and results. It will generate report cards for all the students that will contain complete information regarding their CLOs and PLOs completion. If a student is lagging in any PLO, this report will also contain the future prediction for that student in that specific PLO. This system will also contain interfaces to connect with any Learning Management Portal and those can be used by any institution in the future.

2.6 Sustainable Development Goal (SDG)

The SDG that will apply to our system is "Quality Education," which strives to provide all people with access to high-quality education that is inclusive and equitable and to promote opportunities for lifelong learning. By concentrating on student learning outcomes, offering targeted interventions and assistance to students, and helping teachers and administrators in making data-driven decisions to enhance learning outcomes, our OBE system is specifically created to promote quality education. Secondly, ‘Partnership for Goals’, by encouraging partnerships between educational institutions, educators, students, and administrators, our system may also help to accomplish this SDG by encouraging cooperation and the exchange of best practices in order to achieve the shared objective of enhancing educational outcomes. Lastly, ‘Industry, Innovation and Infrastructure’, our system is intended to be a cutting-edge method for controlling and enhancing the educational process, leveraging data analytics and technology to support educators' and administrators' informed decisions. When industries are rapidly changing or growing, skill-based education can ensure workers have the most up-to-date skills and knowledge. Our system will help to achieve this goal of outcome base education.

2.7 Constraints

2.7.1 End-User Environment

A web browser must be installed in the system of the user so that he can use the web application on it.

2.7.2 Availability or volatility of resources

High speed and uninterrupted internet are required for better performance.

2.7.3 Language Constraints

The system is only useful to those who are familiar with English language.

2.7.4 Data repository and distribution Requirements

For web applications, data storage, and retrieval, online cloud-based databases will be employed. It can only be changed by the administrator.

2.7.5 Interface Protocol Requirements

HTTP protocol will be used for communication between client and server.

2.7.6 Security Requirements

The user must be verified by logging into the system using the credentials provided by the admin. Any other user will not be able to log into the system.

2.8 Business Opportunity

As a strategy to enhance student learning outcomes and better align education with industry needs, outcome-based education (OBE) has attracted a lot of interest recently. By concentrating on learning objectives and evaluating students based on their capacity to accomplish those objectives, OBE is fundamentally intended to improve student learning outcomes. The skills gap that arises in many industries can also be addressed with OBE. OBE can assist guarantee that graduates are well-prepared for the job and can start their chosen careers off on the right foot by concentrating on skills and competences that are in great demand among companies. Several higher education accrediting agencies demand that schools have clearly defined learning outcomes and assessment procedures in place.

By enhancing student learning outcomes, a system that implements the OBE goals and objectives will have considerable positive effects on educational institutions, teachers, and students. Selling the system to educational institutions is one of the most straightforward economic opportunities connected with an outcome-based education system. An AI-powered education system may offer a convincing solution to the challenges that many colleges and universities are trying to solve regarding improving student performance. In addition to selling the system, we could also provide consulting and training services to assist organizations in integrating the system into their current infrastructure. Providing technical support, assisting with data migration, and training instructors and administrators on how to use the system efficiently.

2.9 Stakeholders Description/ User Characteristics

A stakeholder is a person or group of people who all have an interest in a project or organization and in the consequences of that project or organization. Major stakeholders in the OBE system are administrators, teachers, students, IT team (developers) and external stakeholders i.e., accreditation bodies.

2.9.1 Stakeholders Summary

2.9.1.1 Roles of Stakeholders

- **Administrators:**
  They will be responsible for managing the system, they will have different privileges and will have different interfaces from other users. They can create, manage and update learning outcomes for various courses using this system.

- **Teachers:**
  They will enter student evaluation data into the system. They oversee making sure the assessment data is accurate and current. They will be able to create reports on student performance using the system, which will include competency levels, areas of strength and weakness, and overall growth.

- **Students:**
  They will only be allowed to view the report generated by the system at the end of the semester. They can receive feedback and counseling on their performance by respective teachers.

- **IT team:**
  They play a significant part in creating the system and making sure it adheres to the guidelines and standards of the educational institution. The developers' responsibilities include system design, coding, testing, debugging, and implementation. They also offer technical advice and support to other project stakeholders. They can help make the system technically sound, scalable, secure, and user-friendly by providing valuable input.

- **Accreditation Bodies:**

They will assess the institution's compliance with the accrediting standards and regulations using the system, for example NCACE.

2.9.2 Key High-Level Goals and Problems of Stakeholders

2.9.2.1 Key High-Level Goals of Stakeholders

The key high-level goals of stakeholders are as following:

- Enhancing the quality of education
- Improving the teaching methodologies
- Competitive learning
- Focusing more on practical work
- Preparing the students for their professional life

2.9.2.2 Problems of Stakeholders

- Communication issues
- Lack of modern facilities in the institutes
- Lack of interest of students
- Evaluations on merit

2.10 Conclusion

In conclusion, this chapter has described the nature of the problem that how the traditional evaluation system leads to a mismatch between the curriculum and the targeted learning outcomes, leaving students unprepared for challenges in the real world and how our system will fulfill these gaps. It also described the scope of the project, the significant business opportunities and a summary of the stakeholders with their high-level goals and problems.

Chapter 3: Literature Review / Related Work

3.1 Definitions, Acronyms, and Abbreviations

OBE: Outcome-Based Education
NBA: National Board of Accreditation
MMCOE: Marathwada Mitra Mandal’s College of Engineering
PEO: Programme Educational Objectives
PO: Programme Outcomes
CO: Course Outcomes

3.2 Detailed Literature Review

In the area of outcome-based education (OBE), several institutions and departments do extensive research. Below are a handful of those studies that are discussed:

3.2.1 Implementation of Outcome Based Education: A Beginning

Since the National Board of Accreditation (NBA) made outcome-based education (OBE) a requirement for accreditation, several engineering colleges have implemented it. OBE focuses on the goals and results of an engineering program, and proof is needed to show that the predetermined goals have been attained. OBE is more learner-centric than traditional learning and puts the student at the center of the learning process. All undergraduate programs at Marathwada Mitra Mandal's College of Engineering (MMCOE) now use OBE.

3.2.1.1 Summary of the research item

The transition process of Marathwada Mitra Mandal's College of Engineering (MMCOE) towards full Outcome Based Education (OBE) implementation is discussed in the study. This involves modifying the internal evaluation procedure and placing an emphasis on transdisciplinary real-world challenges. The achievement of Graduate Attributes, Program Outcomes, and ongoing quality improvement are the main priorities. The 2014 launch of the implementation process is currently ongoing. The procedure has benefited teaching and learning and inspired both students and faculty to achieve success.

3.2.1.2 Critical analysis of the research item

The following are important components of OBE (Outcome-Based Education): vision, mission, PEOs, POs, COs, teaching-learning process, and evaluation. POs are more specific statements that outline what graduates are expected to know and be able to achieve. They are connected to pupils' knowledge, abilities, and conduct. The course objectives (COs), which are unique to each course, outline the knowledge and skills that students should have by the completion of each course. In a CO-PO mapping matrix, COs are mapped to POs and, depending on the degree of connection, are weighted by one of three correlation factors (1, 2, or 3). Based on the established POs and COs, the teaching-learning process is organized to guarantee successful student learning. Evaluation of the accomplishment of COs and POs by one or more procedures, either directly or indirectly, is known as assessment.

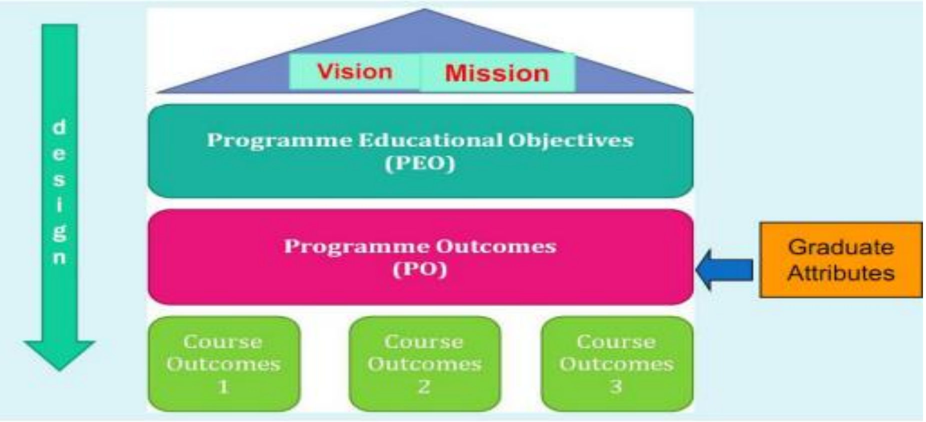


Figure 1: Structure of OBE

3.2.1.3 Relationship to the proposed research work

This study goes through the process of implementing the OBE system in a university where traditional methods of education were used. This process of going through all the steps of implementing OBE can help us a lot in implementing our own project.

3.2.2 Impact of Outcome-Based Education on Accounting Degree Programs

The Ministry of Higher Education in Malaysia has focused on improving university performance and student outcomes in the last ten years, with a particular emphasis on producing well-rounded graduates with entrepreneurship skills. Outcome-based education (OBE) has been adopted to meet these demands, with varying success reported in different studies. This paper examines the implementation of OBE in Accounting Degree Programs offered by Public Universities, focusing on four principles: design down, clarity of focus, extended opportunity, and high expectation. The study looks at students' experiences to assess the level of OBE implementation.

3.2.2.1 Summary of the research item

This study examines the use of Outcome-based Education (OBE) in higher education's accounting degree programs. It examines definitions, developments, and classification of results, and evaluates OBE implementation using the four-principle model. Existing research is reviewed to identify benefits, drawbacks, and key areas for development. The study concludes that assessing the success of OBE implementation is best done through student’s academic experiences in higher education. The four principles of OBE (Outcomes-Based Education) by Spady are Clarity of Focus, Expanded Opportunity, High Expectations, and Design Down.

3.2.2.2 Critical analysis of the research item

The four principles of Outcome-Based Education (OBE) ought to be applied uniformly. According to earlier studies, implementing OBE mechanically without changing teaching, attitudes, or evaluation methods does not lead to ongoing development. The OBE goals should be the main emphasis of a good course experience. The grades of the students could not accurately represent the course's learning objectives or the results of the evaluation of OBE implementation. Course outcomes are significant indicators of program outcomes, as the achievement in course outcomes becomes building blocks towards program outcomes.

3.2.2.3 Relationship to the proposed research work

This article focuses mainly on four principles of OBE and how they are evaluated throughout the past decade and that evaluation helps us get an idea of strengths and weaknesses of OBE and what supporting things an OBE system needs for it to achieve its goal.

3.2.3 Challenges in Implementing Outcome-Based Education

In recent years, the implementation of outcome-based education and student-centered learning has received top priority from Afghanistan's Ministry of Higher Education. As a result, the purpose of this study is to investigate the opinions of Afghan professors regarding recent modifications to the country's educational system.

3.2.3.1 Summary of the research item

In order to better understand how Afghan professors, feel about implementing outcome-based education in their country's educational system, a research was conducted. 120 professors and 7 experts in outcome-based education participated in the researcher's collection of quantitative and qualitative data. The quantitative results showed that although outcome-based education is presently being implemented at a modest level, instructors have good attitudes towards it. A content-based curriculum, policies of teaching, learning, and evaluation, a lack of fundamental infrastructure and information-structure, a lack of facilities, and the burden of teachers were among the major issues revealed by the qualitative research. The outcomes can support future emphasis on this recent paradigm change and aid in the development of appropriate policies. The study also opens new research directions and gives instructors a comprehensive view of outcome-based education and student-centered learning.

3.2.3.2 Critical analysis of the research item

According to the quantitative study, most respondents (46.04%) believed that OBE-SCL was a successful teaching and learning strategy, with 37.50% expressing agreement and 46.04% strongly agreeing. Most instructors disagree and continue to employ conventional evaluation techniques when it comes to being prepared to create an OBE-SCL classroom atmosphere and provide cooperative, meaningful, well-directed activities.

3.2.3.3 Relationship to the proposed research work

This in-depth experiment with multiple teachers and outcome-based education experts lets us get a good insight to the difficulties that come along with implementing an OBE system and will help us overcome them.

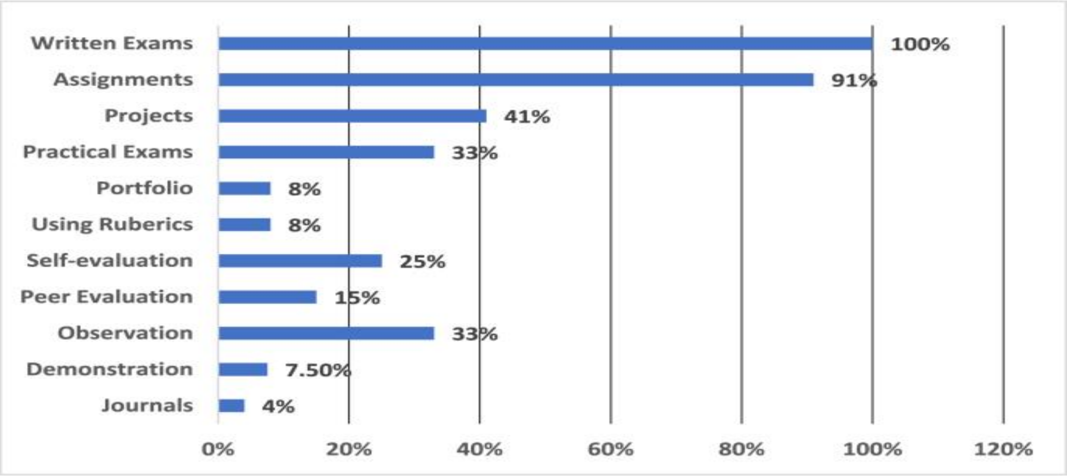


Figure 2: Assessment methods that lecturers use for grading students

3.3 Literature Review Summary Table

Table 1: Literature Reviews Summary

The summary of the literature reviews

No.	Name, reference	Inventor	Year	Input	Output	Description
1.	Implementation of Outcome Based Education: A Beginning [1]	S. Priya	2016	Excel based data of students from assessments	A report regarding attainment of POs and COs	An Engineering College implementation of OBE using direct and indirect assessment methods and manual data entry and processing
2.	Implementation Of Outcome-Based Education (OBE) In Accounting Program In Higher Education [2]	Y. Rohaila, O. Norasmah	2017	Implementation of OBE in accounting degree programs	Evaluation of implemented OBE systems	Based on four principles of Outcome Based System the implementations adopted by Public Universities are examined.
3.	Implementing outcome-based education and student-centered learning in Afghan public universities: the current	R. Katawazai	2021	Quantitative and qualitative data from lecturers and OBE experts	Strengths and weaknesses of currently implemented OBE systems and challenges faced by them	Data collected from 120 lecturers and 7 OBE experts is evaluated to see what challenges are faced by OBE systems and what supporting things are needed to ensure successful implementation of OBE

	practices and challenges [3]					

3.4 Conclusion

The literature review was based on the related works done by other teams previously on OBE systems. We can see from the articles that some universities have tried to implement OBE before as well and their response to OBE is mostly positive but a main complaint is lack of proper things needed to make OBE effective such as methods of evaluation and teaching used and teachers not being equipped properly to make things work.

Chapter 4: Software Requirement Specifications

The features, functional requirements, non-functional requirements, hardware and software requirements, assumptions, use cases, GUI, database architecture, and risk analysis are all covered in this chapter on software requirement specification.

4.1 List of Features

- Login Functionality
- Excel sheets uploading
- Data updating
- Excel sheets generation
- Report card generation
- Recording of Statistics
- Graph generation
- Future Prediction
- Effort Analysis

4.2 Functional Requirements

- The user shall be able to log into the system.
- The admin shall be able to upload the master sheets.
- The teacher shall be able to generate the excel sheets for each section.
- The user shall be able to update the CLOs and PLOs
- The user shall be able to update the courses and sections.
- The teacher shall be able to upload the final excel sheet to the system.
- The teacher shall be able to generate a report card for each student.
- The system shall be able to generate the report card with proper conventions.
- The system shall be able to record the statistics.
- The system shall be able to perform future predictions in that report card.
- The user shall be able to see different graphs.

4.3 Quality Attributes

Some of the quality attributes for our project are listed below:

4.3.1 Usability

- This project will contain easy to use interfaces so that users can use this application easily.
- This project will contain updated versions of all the frameworks used to enhance the smooth usability of the system.

4.3.2 Flexibility

- The system will focus on flexibility by making sure that all the components are loosely coupled.
- The system will be easy to upgrade and maintain.
- The system will be able to link to any Learning Management Portal.
- The system shall be able to adapt to new designs.

4.3.3 Security

- The system will contain an authentication and authorization mechanism.
- The system will contain strong defense mechanisms against intrusion attacks.
- The system will follow good data encryption methods.

4.4 Non-Functional Requirements

Some of the functional requirements are listed below:

4.4.1 Reusability

- The system will comprise of different components coupled together.
- The components will be designed in such a way that they are reusable for future deployments.
- Every component will carry out a different individual job.

4.4.2 Performance

- The system will perform fine under stressful conditions.
- The system will have updated versions of all the frameworks to insure smooth performance.
- The system will be able to cater for multiple users at a time.
- If under stressful conditions, the system will manage the stressful condition efficiently.

4.4.3 Extensibility

- The system will be open to multiple extensions planned down the road.
- The system will be highly scalable.

4.4.4 Availability

- The system will be available to the user whenever required.
- The maintenance will be done in the timeframe when the system in the least demand.

4.5 Assumptions

Despite the great degree of compatibility of this software system, several assumptions and dependencies must still be considered for the program to function at its best. The list of the assumptions is as following:

- Operating System
- A stable internet connection
- An up-to-date web browser
- Hardware resources

4.6 Hardware and Software Requirements

To develop and run this system, the following Hardware and Software specifications are recommended.

4.6.1 Hardware Requirements

For development and execution, the following hardware specifications are recommended:

- A Desktop/Laptop computer
- A 64-bit operating system
- A stable internet connection
- 8 GB of RAM

4.6.2 Software Requirements

For development and execution, the following software specifications are recommended:

- A web browser
- Visual Studio Code
- PyCharm
- Microsoft Excel or any alternative

4.7 Use Cases

The use cases and their description for our project are mentioned below:

4.7.1 Login

Table 2: Login

The description of login use case

Name	Login		
Actors	Admin, Teacher		
Summary	The user shall provide their credentials on the login form and after successful verification, will be redirected to the home page.		
Pre-Conditions	The user must be in the database records either added by any of the authorized users or added manually by a developer. The user must not already be logged in.		
Post-Conditions	The user’s session is successfully established and shall be redirected to the home page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user opens the login page.	2	The login page is displayed asking for email and password.

4.7.2 Sign out

Table 3: Sign-out

This description of sign out use case

Name	Sign-out
Actors	Admin, Teacher
Summary	The user shall be able to log out of their profiles.

Pre-Conditions	The user must be logged in already.		
Post-Conditions	The user’s session is ended and they are redirected to the login page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the logout button and clicks yes.	2	The session is ended and the user is redirected to login page.
No Alternative Flow			

4.7.3 Upload Master Sheet

Table 4: Upload Master Sheet Use Case

The description of Upload Master Sheet Use Case

Name	Upload Master Sheet		
Actors	Admin		
Summary	The admin will upload the master sheet regarding the entire degree containing the courses in each semester, their CLOs and the PLO-CLO mapping.		
Pre-Conditions	The admin must be logged in already.		
Post-Conditions	The master sheet is uploaded and the contents are saved in the database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the upload master sheet button.	2	A box is opened which lets the user select the required file.
3	The user selects the master sheet to upload.	4	The sheet is uploaded and all of its contents are saved in the database.
Alternative Flow			
3	The user selects the wrong file to upload.	4-A	The system responds with an error message: *Incorrect file format.*

4.7.4 Upload Sections Sheet

Table 5: Upload Sections Sheet Use Case

The description of Upload Sections Sheet Use Case

Name	Upload Section Sheet
Actors	Admin
Summary	The admin will upload the section sheet regarding the entire degree containing the sections of each course and the teacher assigned to that course.

Pre-Conditions	The admin must be logged in already.		
Post-Conditions	The section sheet is uploaded, and the contents are saved in the database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the upload section sheet button.	2	A box is opened which lets the user select the required file.
3	The user selects the section sheet to upload.	4	The sheet is uploaded and all of its contents are saved in the database.
Alternative Flow			
3	The user selects the wrong file to upload.	4-A	The system responds with an error message: *Incorrect file format.*

4.7.5 Update Master Sheet

Table 6: Update Master Sheet Use Case

The description of Update Master Sheet Use Case

Name	Update Master Sheet		
Actors	Admin		
Summary	The admin will be able to update a master sheet if it is already uploaded.		
Pre-Conditions	The master sheet must be uploaded		
Post-Conditions	The master sheet is updated and the contents are saved in the database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the edit master sheet button.	2	The system lets the user select the fields to edit.
3	The user edits the data uploaded by the sheet.	4	The data is updated in the database.
Alternative Flow			
3	The user updates a wrong field.	4-A	The system responds with an error message: *Incorrect field type.*

4.7.6 Update Section Sheet

Table 7: Update Section Sheet Use Case

The description of Update Section Sheet Use Case

Name	Update Section Sheet

Actors	Admin		
Summary	The admin will be able to update the section sheet.		
Pre-Conditions	The section sheet must be uploaded		
Post-Conditions	The section sheet is updated and the contents are saved in the database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the update section sheet button.	2	The system lets the user select the fields to edit.
3	The user edits the data uploaded by the sheet.	4	The data is updated in the database.
Alternative Flow			
3	The user updates a wrong field.	4-A	The system responds with an error message: *Incorrect field type.*

4.7.7 Download Progress Sheet

Table 8: Download Progress Sheet Use Case
The description of Download Progress Sheet Use Case

Name	Download Progress Sheet		
Actors	Teacher		
Summary	The teacher will be able to download a progress sheet for each of their sections which will record the progress of each student throughout the semester.		
Pre-Conditions	The admin must be logged in and assigned a section.		
Post-Conditions	A progress sheet is downloaded in the system		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The teacher clicks the generate sheet button.	2	The sheet is downloaded in the system.
No Alternative Flow			

4.7.8 Upload Final Progress Sheet

Table 9: Upload Final Progress Sheet Use Case
The description of Upload Final Progress Sheet Use Case

Name	Upload Final Sheet

Actors	Teacher		
Summary	The teacher will upload a final progress sheet that they have filled throughout the semester so that the system may generate the results.		
Pre-Conditions	The teacher must have downloaded the progress sheet.		
Post-Conditions	The completed progress sheet is uploaded and the contents are saved in the database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The teacher clicks the upload final sheet button.	2	A box is opened which lets the user select the required file.
3	The teacher selects the final sheet to upload.	4	The sheet is uploaded and all of its contents are saved in the database.
Alternative Flow			
3	The user selects the wrong file to upload.	4-A	The system responds with an error message: *Incorrect file format.*

4.7.9 Generate Report Card

Table 10: Generate Report Card Use Case
The description of Generate Report Card Use Case

Name	Generate Report Card		
Actors	Teacher		
Summary	The teacher will be able to generate a report for each of their student which will contain their progress and the percentage of PLOs completed by them in that course.		
Pre-Conditions	A final completed sheet must be uploaded to the system by the teacher.		
Post-Conditions	A report card for each student is generated based on the given final sheet.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The teacher clicks the generate report card button.	2	The report cards are generated by the system.
No Alternative Flow			

4.7.10 Display Statistics

Table 11: Display Statistics Use Case
The description of Display Statistics Use Case

Name	Display Statistics		
Actors	Teacher		
Summary	The teacher will be able to see different statistics in a table related to the progress of their students.		
Pre-Conditions	A final completed sheet must be uploaded to the system by the teacher.		
Post-Conditions	Different reports are generated which contain different statistics for the teacher.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The teacher clicks the view statistics button.	2	The reports regarding the statistics are generated.
No Alternative Flow			

4.7.11 Generate Graphs

Table 12: Generate Graphs
The description of Generate Graphs Use Case

Name	Generate Graphs		
Actors	Teacher		
Summary	The teacher will be able to see different statistics in graphs related to the progress of their students.		
Pre-Conditions	A final completed sheet must be uploaded to the system by the teacher.		
Post-Conditions	Different reports are generated which contain different statistics in a graphical view for the teacher.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The teacher clicks the view statistics button.	2	The graphs regarding the statistics are generated.
No Alternative Flow			

4.7.12 Future Prediction

Table 13: Future Prediction Use Case
The description of Future Prediction Use Case

Name	Future Prediction
Actors	System
Summary	After all the sheets are uploaded, the system will be able to do some

<table>
<tr><td colspan="2"></td><td colspan="2">future prediction and let the teachers know which of the student require more attention and when will they be able to complete their lagging PLOs.</td></tr>
<tr><td colspan="2"><b>Pre-Conditions</b></td><td colspan="2">A final completed sheet must be uploaded to the system by the teacher.</td></tr>
<tr><td colspan="2"><b>Post-Conditions</b></td><td colspan="2">The model will let the teacher know about these statistics in the report card.</td></tr>
<tr><td colspan="2"><b>Special Requirements</b></td><td colspan="2">None</td></tr>
<tr><td colspan="4"><b>Basic Flow</b></td></tr>
<tr><td colspan="2"><b>Actor Action</b></td><td colspan="2"><b>System Response</b></td></tr>
<tr><td>1</td><td>The teacher clicks the generate report card button.</td><td>2</td><td>The report cards are generated with the future prediction by the system.</td></tr>
<tr><td colspan="4"><b>No Alternative Flow</b></td></tr>
</table>

4.8 Graphical User Interface

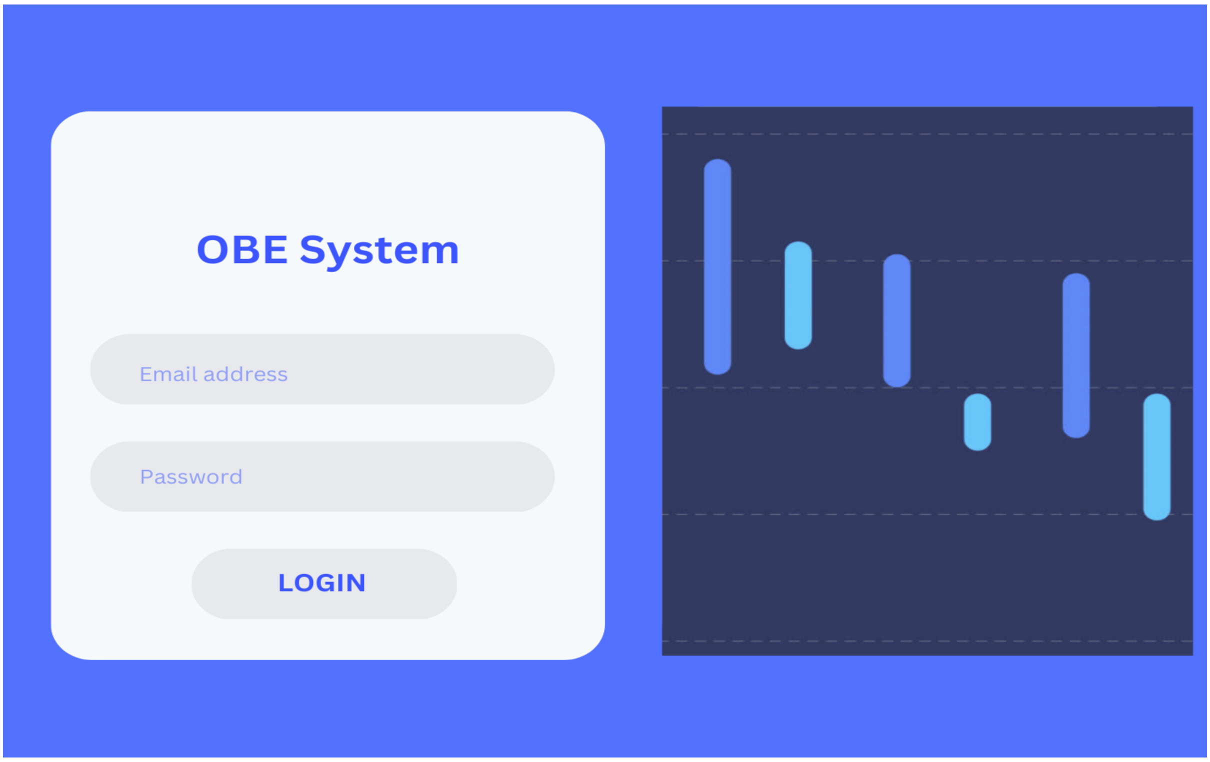
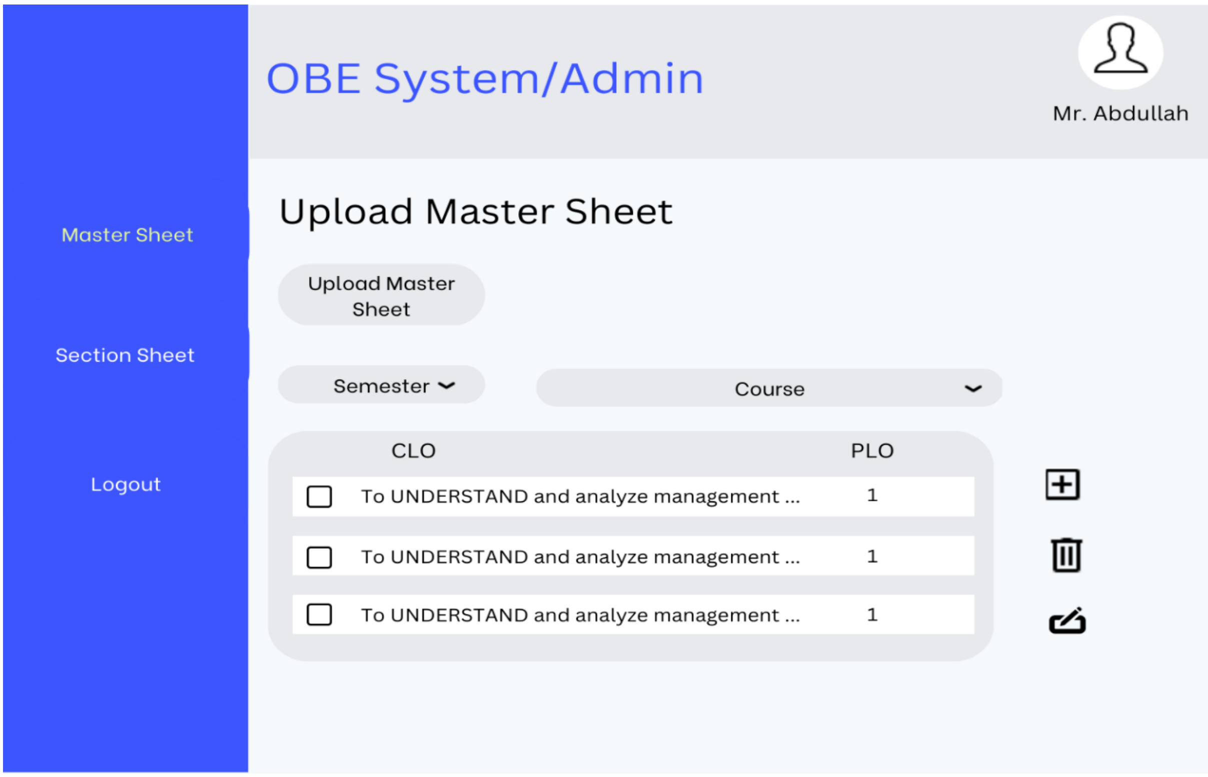


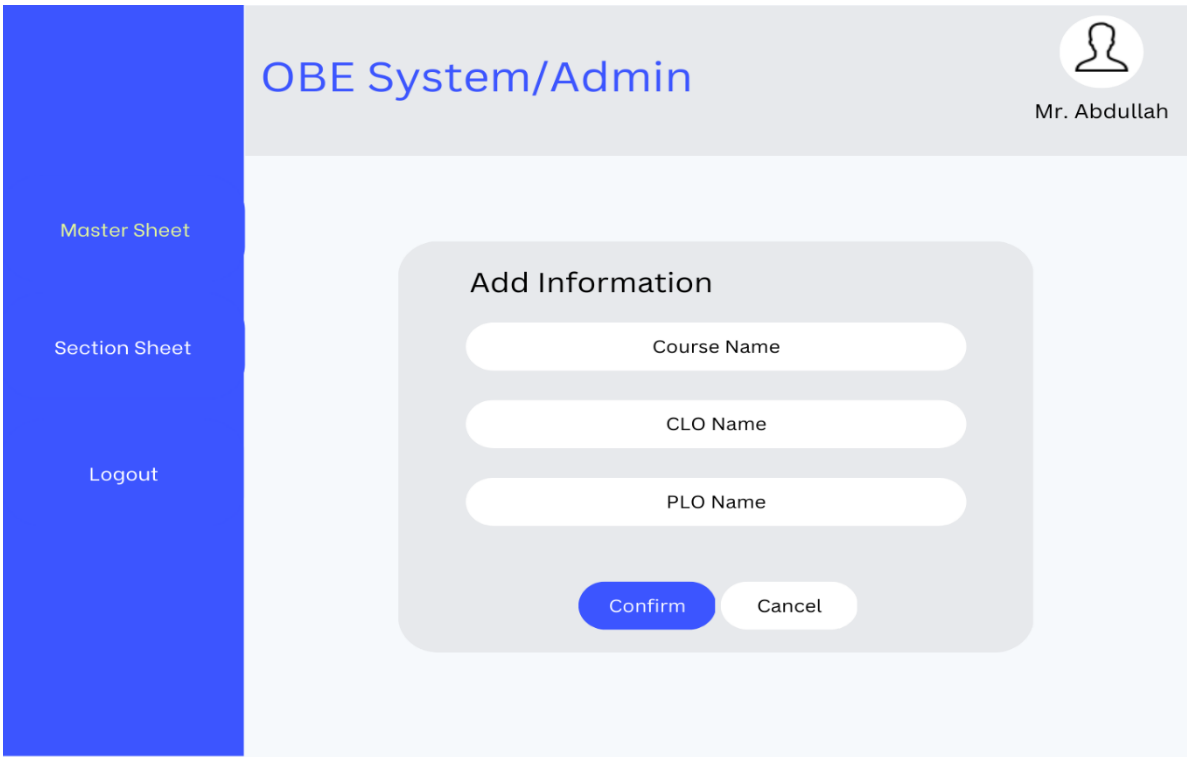
Figure 3: Login Page
The design of login page



Upload Master Sheet

	CLO	PLO
□	To UNDERSTAND and analyze management ...	1
□	To UNDERSTAND and analyze management ...	1
□	To UNDERSTAND and analyze management ...	1

Figure 4: Upload Master Sheet Page
The design of Upload Master Sheet Use Case



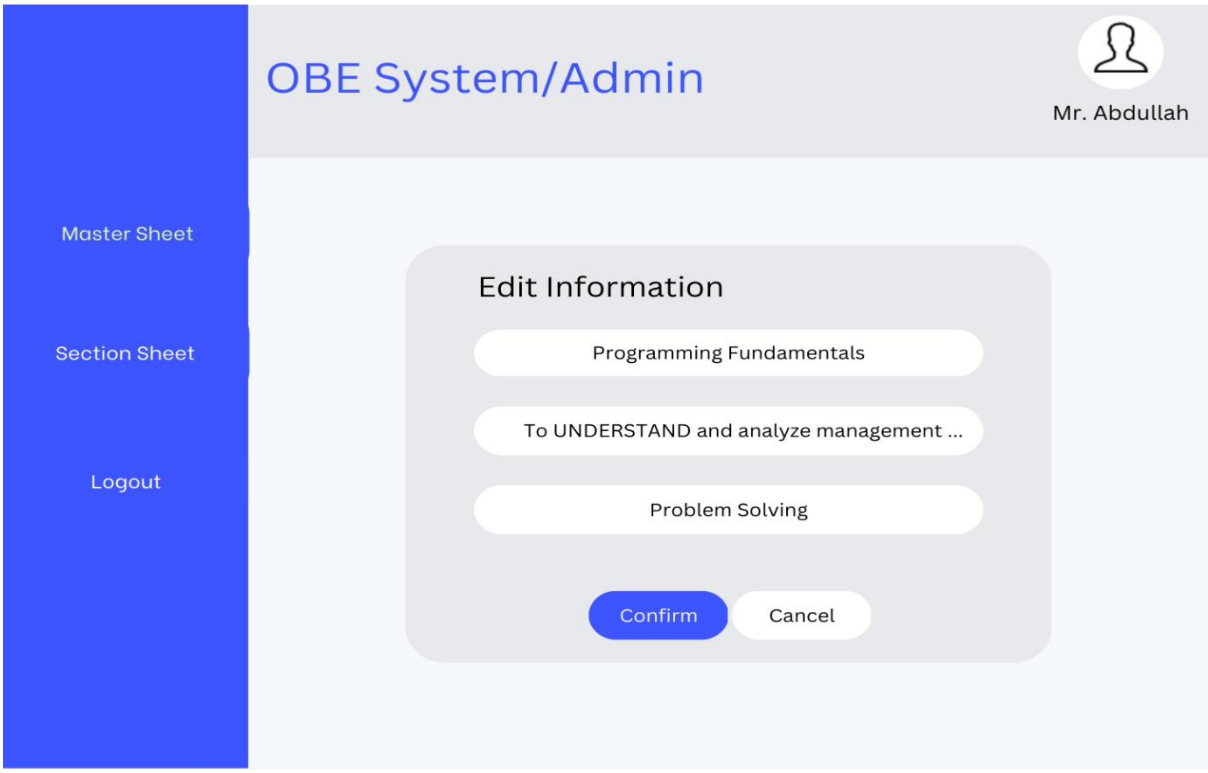
Add Information

Course Name

CLO Name

PLO Name

Figure 5: Add Information Box
The design of Add Information Box



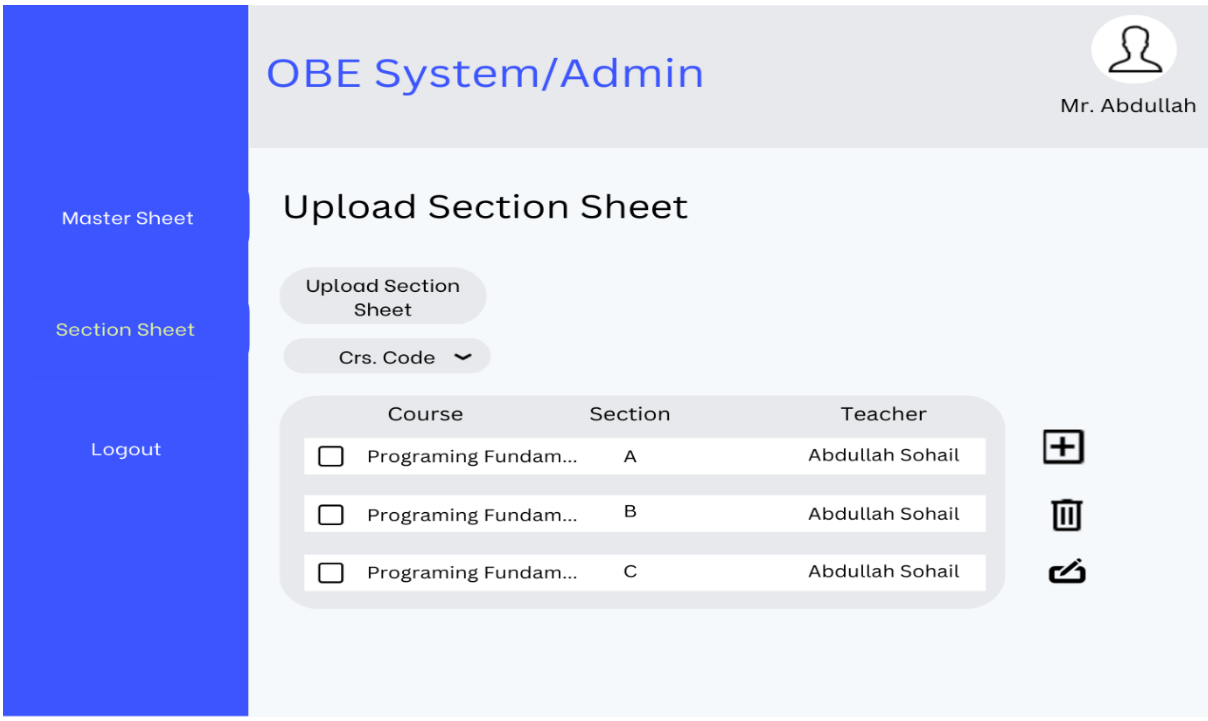
Edit Information

Programming Fundamentals

To UNDERSTAND and analyze management ...

Problem Solving

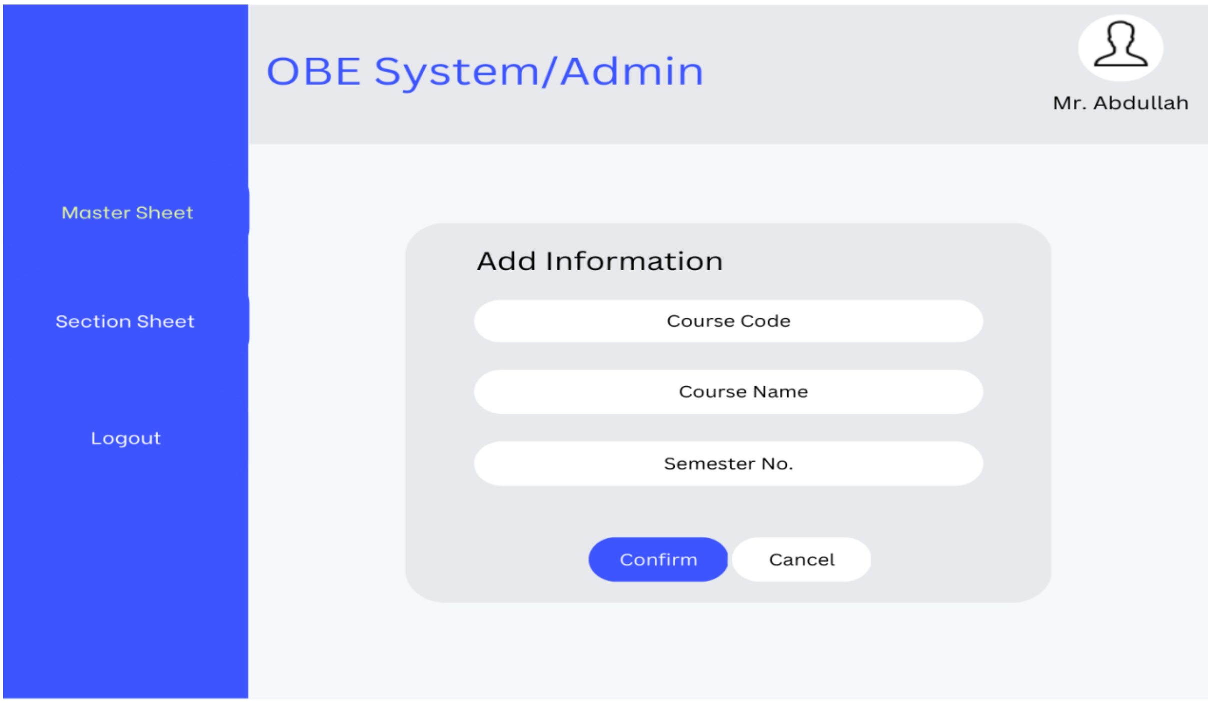
Figure 6: Edit Information
The design of Edit Information Box



Upload Section Sheet

	Course	Section	Teacher
□	Programing Fundam...	A	Abdullah Sohail
□	Programing Fundam...	B	Abdullah Sohail
□	Programing Fundam...	C	Abdullah Sohail

Figure 7: Upload Section Sheet
The design of Upload Section Sheet Use Case



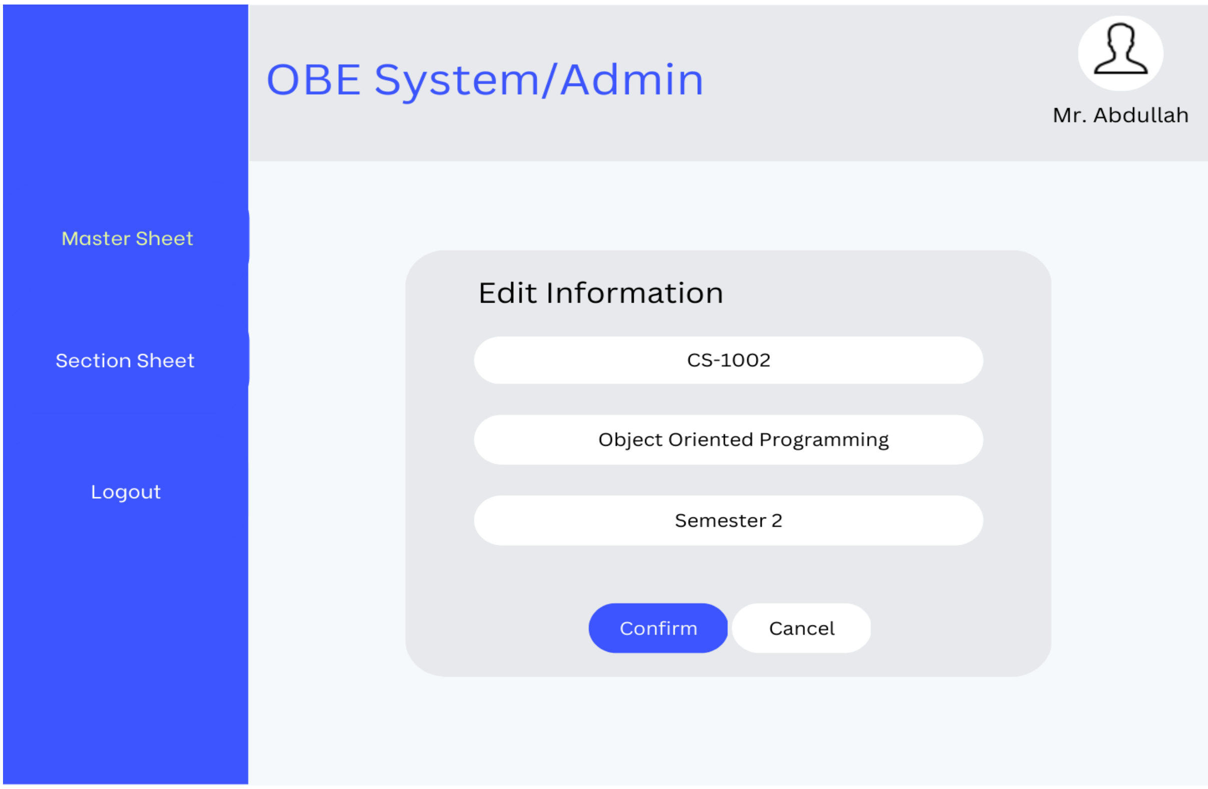
Add Information

Course Code

Course Name

Semester No.

Figure 8: Add Section Information
The design of Add Information Page



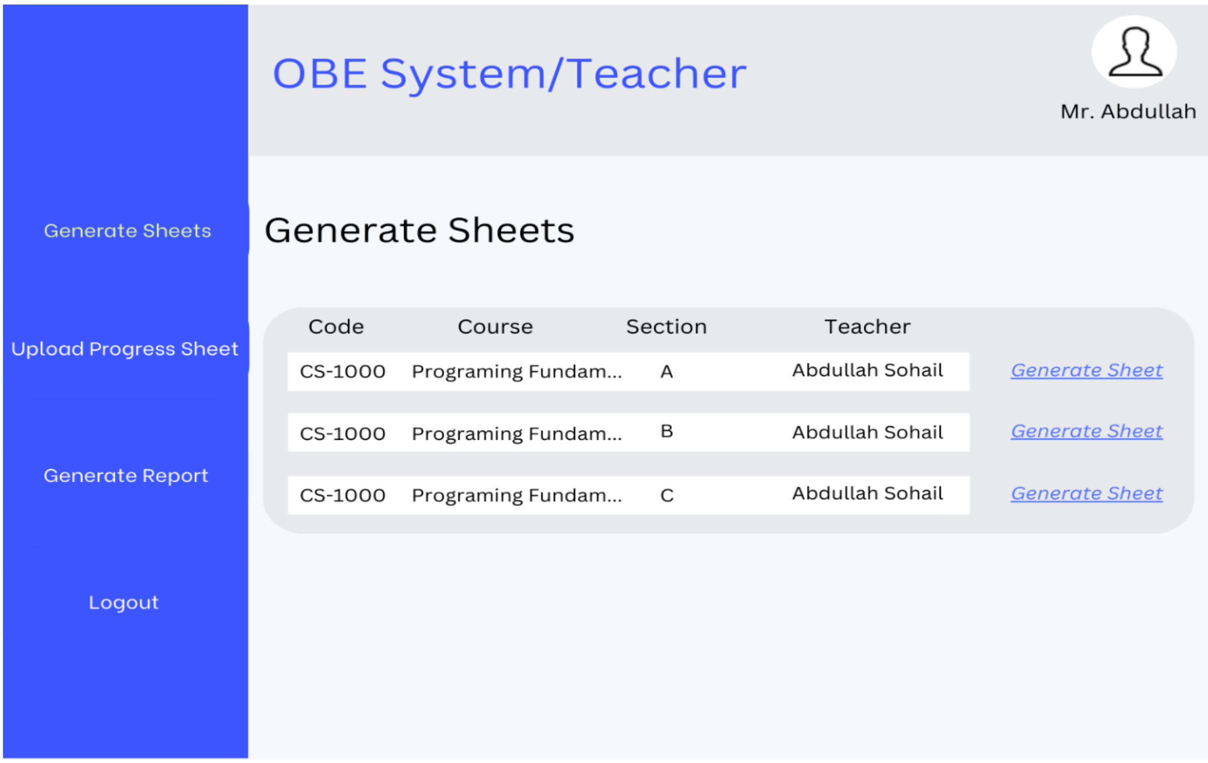
Edit Information

CS-1002

Object Oriented Programming

Semester 2

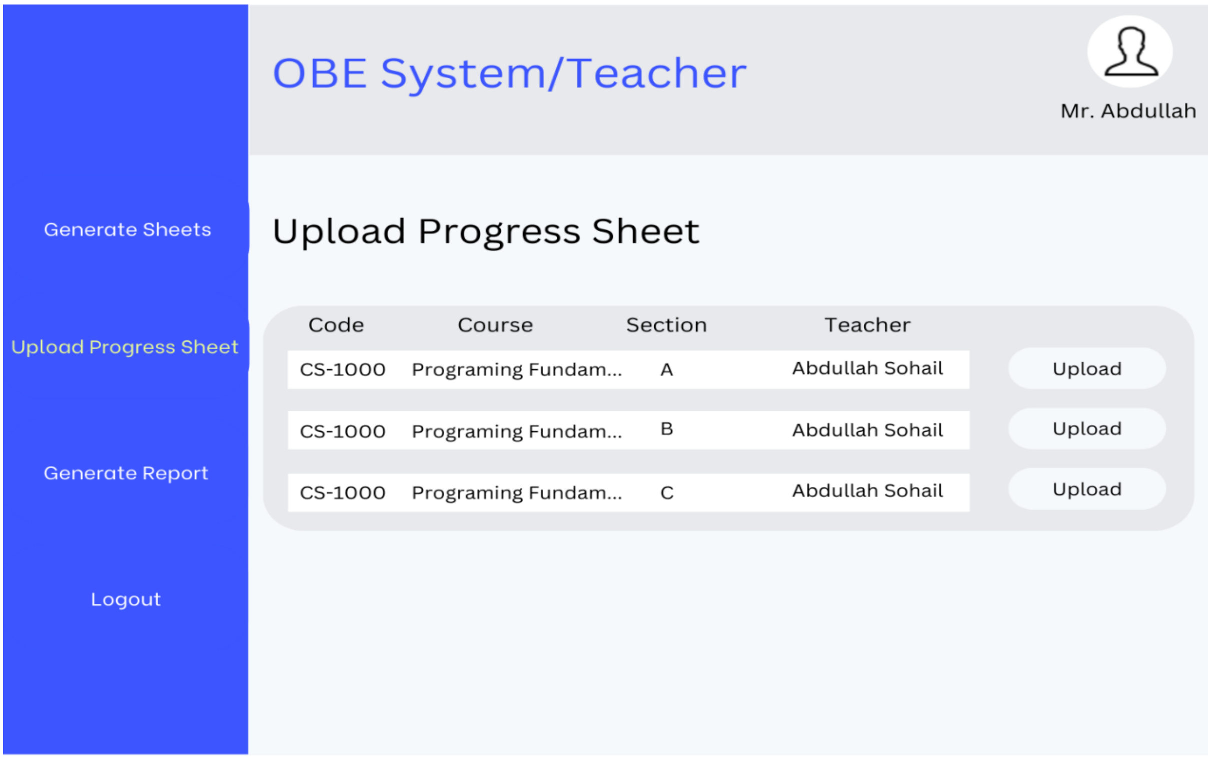
Figure 9: Edit Information
The design of Edit Information Box



Generate Sheets

Code	Course	Section	Teacher	
CS-1000	Programing Fundam...	A	Abdullah Sohail	Generate Sheet
CS-1000	Programing Fundam...	B	Abdullah Sohail	Generate Sheet
CS-1000	Programing Fundam...	C	Abdullah Sohail	Generate Sheet

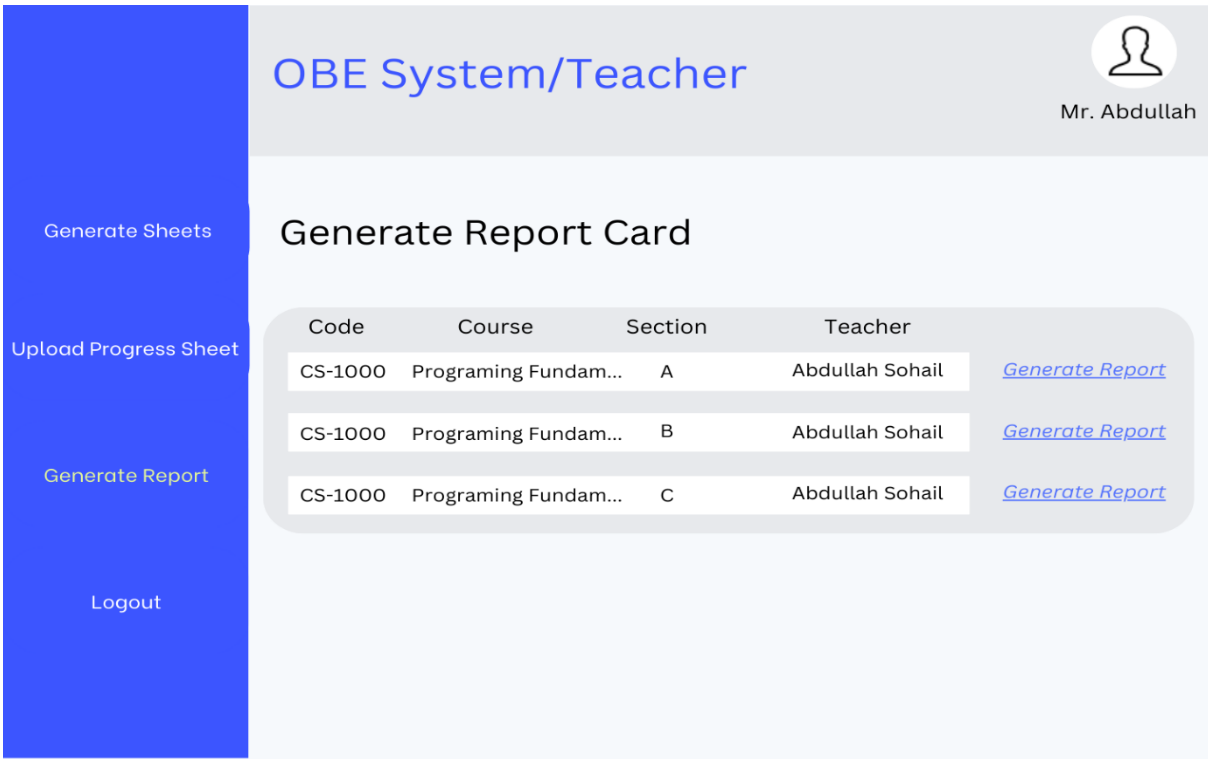
Figure 10: Generate Sheet
The design of Generate Sheet Page



Upload Progress Sheet

Code	Course	Section	Teacher	
CS-1000	Programing Fundam...	A	Abdullah Sohail	Upload
CS-1000	Programing Fundam...	B	Abdullah Sohail	Upload
CS-1000	Programing Fundam...	C	Abdullah Sohail	Upload

Figure 11: Upload Progress Sheet
The design of Upload Progress Sheet Page



Generate Report Card

Code	Course	Section	Teacher	
CS-1000	Programing Fundam...	A	Abdullah Sohail	Generate Report
CS-1000	Programing Fundam...	B	Abdullah Sohail	Generate Report
CS-1000	Programing Fundam...	C	Abdullah Sohail	Generate Report

Figure 12: Generate Report Card
The design of Generate Report Card Page

4.9 Database Design

The ER Diagram and the data dictionary is as following:

4.9.1 ER Diagram

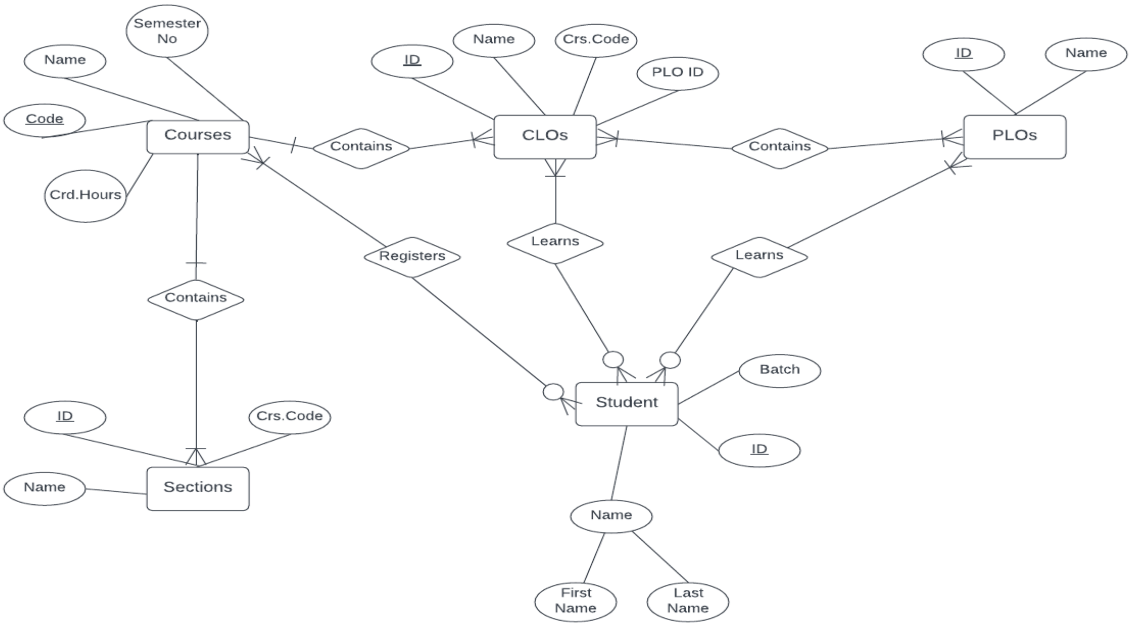


Figure 13: ER Diagram
The Entity Relation Diagram

4.9.2 Data Dictionary

Table 14: Courses Data Dictionary
The dictionary for courses table

Courses				
NAME	**DATA TYPE**	**CONSTRAINT**	**DESCRIPTION**	**EXAMPLE**
Code	varchar	Primary key	Code of the course	CS-1001
Name	varchar	Not null	Name of the course	OOP
Credit Hours	integer	Not null	Credit hours of the course	3
Semester No.	integer	Not null	Semester in which that course is offered	7

Table 15: CLOs Data Dictionary
The dictionary for CLO table

CLOs				
NAME	**DATA TYPE**	**CONSTRAINT**	**DESCRIPTION**	**EXAMPLE**
ID	integer	Primary key	Id of the CLO	232
Name	varchar	Not null	Name of the CLO	To understand Problem solving
Crs. Code	varchar	Foreign key	Code of the course that contains this CLO	CS-1002
PLO ID	integer	Foreign key	Id of the PLO that this CLO is mapped on	12

Table 16: PLO Data Dictionary
The dictionary for PLO table

PLOs				
NAME	**DATA TYPE**	**CONSTRAINT**	**DESCRIPTION**	**EXAMPLE**
PLO ID	integer	Primary key	Id of the PLO	12
PLO Name	varchar	Not null	Name of the PLO	Problem Analysis

Table 17: Sections Data Dictionary
The dictionary for sections table

Sections				
NAME	**DATA TYPE**	**CONSTRAINT**	**DESCRIPTION**	**EXAMPLE**
ID	integer	Primary key	ID of the section	2
Name	varchar	Not null	Name of the section	Section A
Crs. Code	varchar	Foreign key	Code of the course that this section belong to	CS-1001

Table 18: Student Data Dictionary
The dictionary for student table

Student				
NAME	**DATA TYPE**	**CONSTRAINT**	**DESCRIPTION**	**EXAMPLE**
ID	varchar	Primary key	Id of the student	19L-1052
First Name	varchar	Not null	First name of the student	Ali
Last Name	varchar	Not null	Last name of the student	Ahmed
Batch	integer	Not null	Batch of the student	2019

4.10 Risk Analysis

Following are the risks identified in our project:

- There may be any technical issues regarding different browsers supporting our frameworks or not, but we will make sure our project runs on maximum browsers.
- Security-related risks are another concern for this project but we will make sure to use the up-to-date versions of all the frameworks to provide the users with maximum security.
- There may be any hardware or software related issues as well, but we will be cautious in using the most stable software and hardware for our project.
- Changing requirements is yet another risk that can be faced during the development of this project so we will make sure to use the most appropriate development methodology that caters the changing requirements of the client.

Chapter 5: High-Level and Low-Level Design

This chapter majorly covers the high-level and low-level design of our web-based Outcome Based Education (OBE) system.

5.1 System Overview

In this, we will be discussing our system. What the system architecture's, how data flows and how this system works. A system needs a systemic approach to be coherent and functional. It is necessary to use a bottom-up or top-down method to compensate for all the system's connected factors.

5.1.1 Frontend:

The front-end of the OBE system will be developed using the React JavaScript library. The main purpose of the front-end will be to provide a user-friendly interface for administration and faculty members to manage the curriculum, monitor student progress and generate reports. The user interface for admins will include three options that are Master Sheet, Section Sheet and Logout. The user interface for teachers will include four options that are Generate Sheet, Upload Progress Sheet, Generate Report and Logout.

5.1.2 Backend:

The backend of the OBE system will be developed using the Python Django web framework. The backend will be responsible for managing user authentication and authorization, data storage and retrieval, and business logic. The back end will communicate with the front-end using RESTful APIs. Django provides built-in security features such as password hashing and cross-site scripting (XSS) protection. This helps ensure that the OBE system is secure and protected from attacks.

5.1.3 Database:

The database for the OBE system will be developed using SQLite3. The database will be used to store user's information and student's assessment data, course and program learning outcomes, and other relevant information. The database will be accessed by the backend using Object Relational Mapping (ORM) provided by Django. ORM provides a high-level abstraction layer for working with databases that allows developers to interact with the database using familiar programming constructs, such as objects and methods, rather than writing complex SQL queries. This greatly simplifies the process of interacting with the database and reduces the likelihood of errors and inconsistencies.

By using the ORM provided by Django, the OBE system can easily create, update, retrieve and delete records from the database without having to write complex SQL queries. SQLite3 also offers high performance and scalability, allowing the system to handle large amounts of data and users.

5.2 Design Considerations

This section describes many of the issues which need to be addressed or resolved before attempting to devise a complete design solution.

5.2.1 Assumptions and Dependencies

The presumptions or dependencies relating to the software and its usage are listed below.

- User has a Desktop/Laptop computer with 8 GB of RAM and a 64-bit Operating system.
- User has JS enabled browsers installed.
- Users must have a stable internet connection.
- Software specifications required for this system to work include Visual Studio Code, PyCharm, Microsoft Excel or any alternative.

5.2.2 General Constraints

The following are the general constraints of our system which have a major impact on our system's software:

5.2.2.1 Hardware and Software Environment

We are designing a web application, so targeted systems should have JS supported browsers such as Google Chrome or Mozilla Firefox. In the case of hardware, our web application requires 8 GB RAM, 64-bit OS.

5.2.2.2 End-User Environment

The end-user will access the web-application via the internet using the computer browser specified previously.

5.2.2.3 Availability or Volatility of Resources

High speed and uninterrupted internet are required for better performance.

5.2.2.4 Language Constraints

The system is only useful to those who are familiar with English language.

5.2.2.5 Data Repository and Distribution Requirements

For web applications, data storage, and retrieval, online cloud-based databases will be employed. It can only be changed by the administrator.

5.2.2.6 Interface Protocol Requirements

HTTP protocol will be used for communication between client and server. Interface will be implemented using react framework and running on browsers which are mentioned in software requirements.

5.2.2.7 Security Requirements

The user must be verified by logging into the system using the credentials provided by the admin. Any other user will not be able to log into the system. Django framework will provide built-in security features such as password hashing and cross-site scripting (XSS) protection. This helps ensure that the OBE system is secure and protected from attacks.

5.2.2.8 Data Repository and Distribution Requirements

As we are using Django, it uses three different databases from them we will be using SQLite will for storage and retrieval of data for web application.

5.2.2.9 Memory and Capacity Limitations

The system will require memory, bandwidth, and I/O, a CPU for enhanced efficiency.

5.2.2.10 Standards Compliance

The system will adhere to the World Wide Web Consortium's rules and regulations (W3C).

5.2.2.11 Communication Network

Since our application is entirely web, we must accept that a reliable network connection is crucial to the project and may result in the failure of our system in the event of a network failure. Communication across the network via HTTPS.

5.2.2.12 Verification and Validation Requirements

Only users with valid login credentials will be able to access the application, according to the system.

5.2.3 Goals and Guidelines

5.2.3.1 User Friendly Web-App

The major reason to create this web-app was that there was no availability of a fully functional and user-friendly OBE system and faculty members were reluctant to devote the time and effort needed to implement OBE manually, so the main goal is to implement a user-friendly web-app whose interfaces are designed in a way that is easy to navigate and understand for users. It will have a clean and intuitive design, with a clear hierarchy of information and visual cues that guide the user's attention.

5.2.3.2 Promoting Industry Trends

The industry now is more attracted towards the skilled rather than the high achievers and due to this it is necessary to teach the students what is required of them. The OBE system will promote industry readiness among students by aligning the learning outcomes with the industry demands. The system will help teachers to provide real-time feedback to the students on their performance, strengths, and weaknesses, which will help them identify areas for improvement and work on them. This will make the students more competitive in the job. Hence, the OBE system will bridge the gap between academia and industry, making the students industry-ready and increasing their employability.

5.2.4 Development Method

We chose the agile model, specifically the scrum method. When it comes to development, the main justification for using the scrum model is its productivity and quality. Scrum is an agile framework with a focus on software development for creating, delivering, and maintaining complex products. It is an incremental and iterative model. Another advantage that drew us to this approach over others was its flexibility to adapt to changing requirements as we went along. We used the Scrum paradigm to break tasks into sprints, which simplified our job. Following were the steps in each sprint:

1. Planning
2. Implementation
3. Review
4. Retrospect

Scrum is adaptable, making it simpler to change projects or add new functionalities, because it has agility and gives enough strength to application.

5.3 System Architecture

The underlying structure of a system, including all its parts, how they work together, and the ideas and rules that have guided their development, is referred to as system architecture. In order to satisfy the necessary performance, functionality, and quality standards, creating and specifying a system's structure, behavior, and function. Among other disciplines, system architecture may be used in software, hardware, networks, and organizations.

5.3.1 Information Passing Architecture

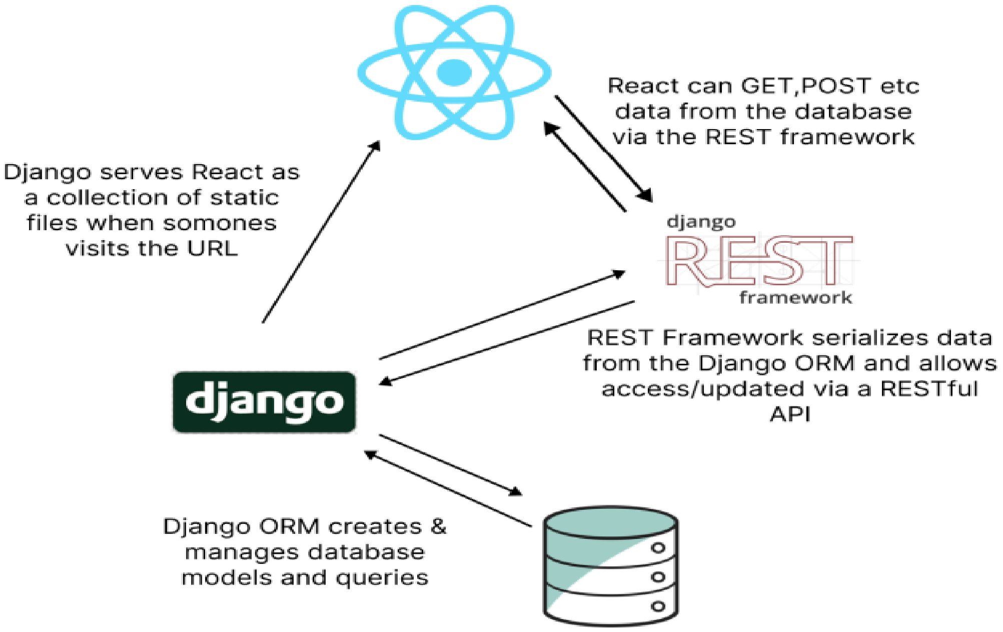


Figure 14: React and Django Message Passing Architecture
The figure shows a diagram of React and Django message passing mechanism.

5.3.2 High-Level Architecture Diagram

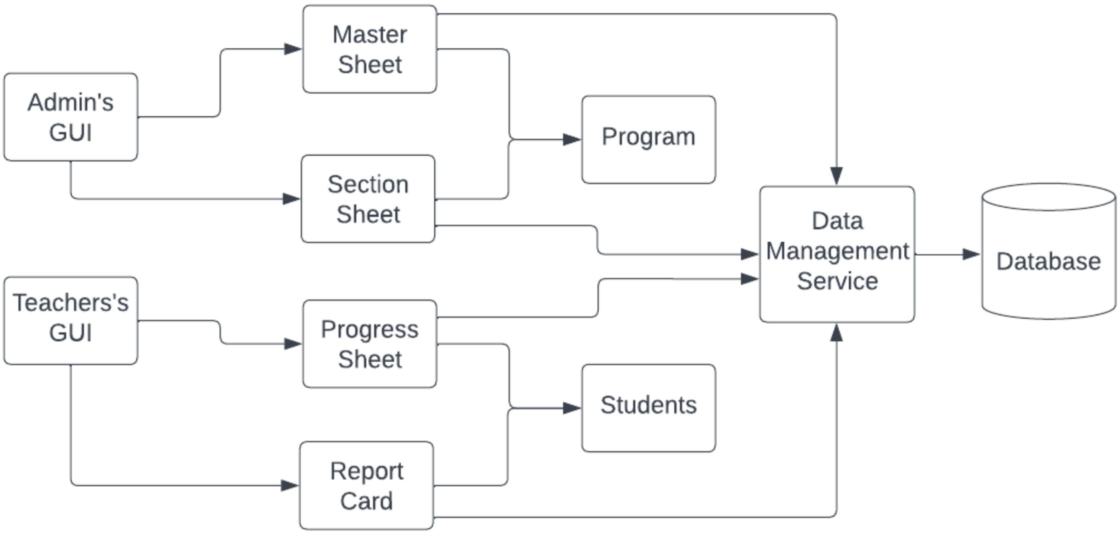


Figure 15: High-Level Architecture Diagram
The figure shows the diagram of the High-Level Architecture

The above diagram shows the high-level architecture of our project. It includes the relationships between different modules of our system. In order to access the database, all of the users have to interact with the Data Management Service module. The service module passes the query to the database from the user and then forwards the response from the database to the user. Hence our project will have a client-server architecture.

5.3.3 Low-Level Architecture Diagram

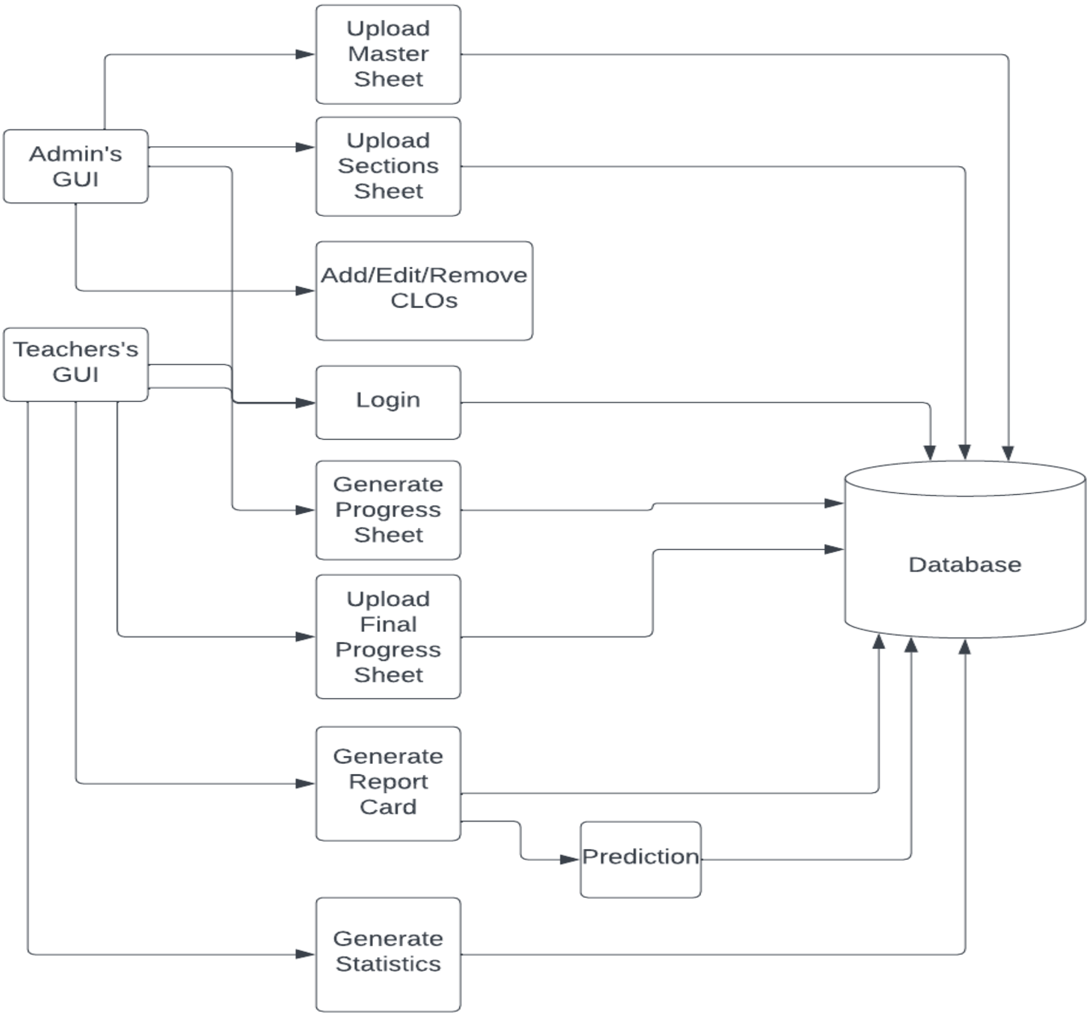


Figure 16: Low-Level Architecture Diagram
The figure shows the diagram of the Low-Level Architecture

The low-level architecture diagrams show the internal dependences and relationships of our project. It shows what kind of privileges each type of user will get. The admin has some authorities like uploading the master sheet, uploading the sections sheet and add, editing or removing any CLO. On the other hand, teachers have the authority to maintain the semesters work in a progress sheet and by the end of the semester generate report cards for each of their student.

5.4 Architectural Strategies

Following are the strategies that are used for designing the architecture of the system and that affect the overall organization of the system and its higher-level structures.

5.4.1 Use of a Particular Type of Product

As our system will be a web-based application it will use following:

- The front-end of the OBE system will be developed using the React JavaScript library.
- The backend of the OBE system will be developed using the Python Django web framework.
- The database for the OBE system will be developed using SQLite3.

5.4.2 Reuse of Existing Software Components

- Built-in libraries of React will be used.
- Built-in functions and libraries from JavaScript will be used.
- Django provides built-in security features such as password hashing and cross-site scripting (XSS) protection.

5.4.3 Future for Extending or Enhancing the Software

- After the completion of our final year project, we want to deploy this system as a proper product that other educational institutions can use.
- Additional features can be implemented to the application later as need be. It can be extended from just a web-application to mobile for accessibility.

5.4.4 Hardware and/or Software Interface Paradigms

The software needed to run would be a basic computer with a browser that has access to internet. Any computer with the hardware that meets above requirements should be able to access our application.

5.4.5 External Databases and/or Data Storage Management and Persistence

We will be using SQLite for our project which saves data on the device so the data will all be stored on one single device and no external data will be needed.

5.4.6 Distributed Data or Control Over a Network

The application will keep data on admin end in a database, so the user must have an internet connection in order to access data. The data will not be available to user offline.

5.4.7 Generalized Approaches to Control

Django provides built-in security features such as password hashing and cross-site scripting (XSS) protection. This helps ensure that the OBE system is secure and protected from attacks.

5.4.8 Communication Mechanisms

The back end will communicate with the front-end using RESTful APIs.

5.5 Domain Model/Class Diagram

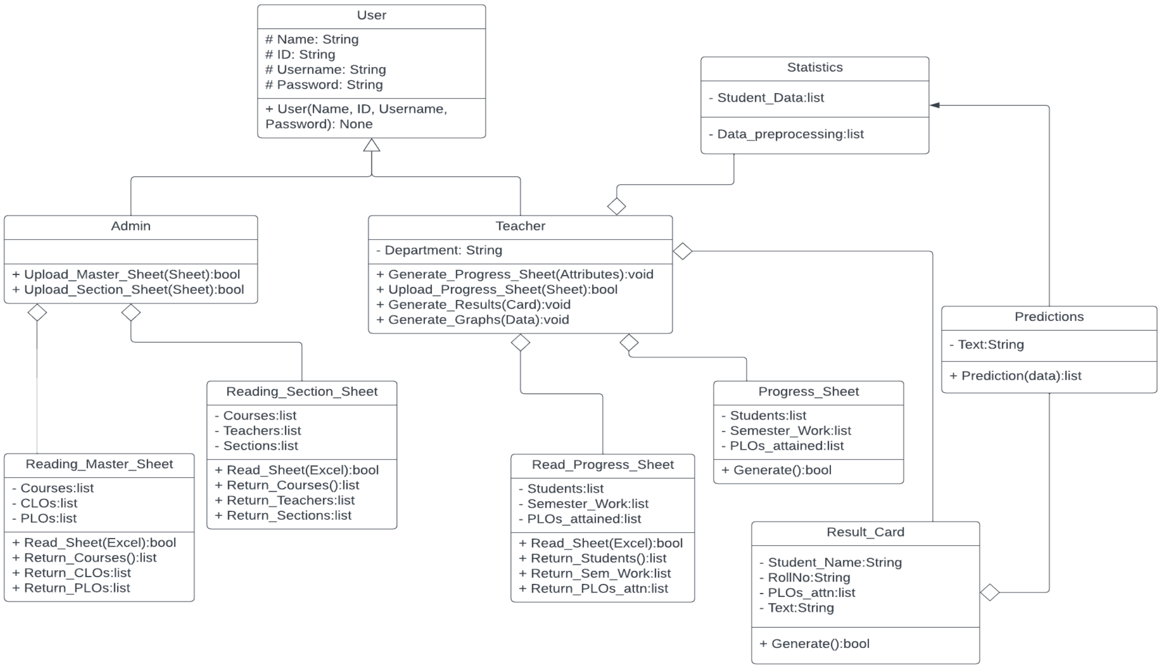


Figure 17: The Class Diagram of Our Project
The Class/Model Diagram of Our Project with all the dependences

5.6 Sequence Diagrams

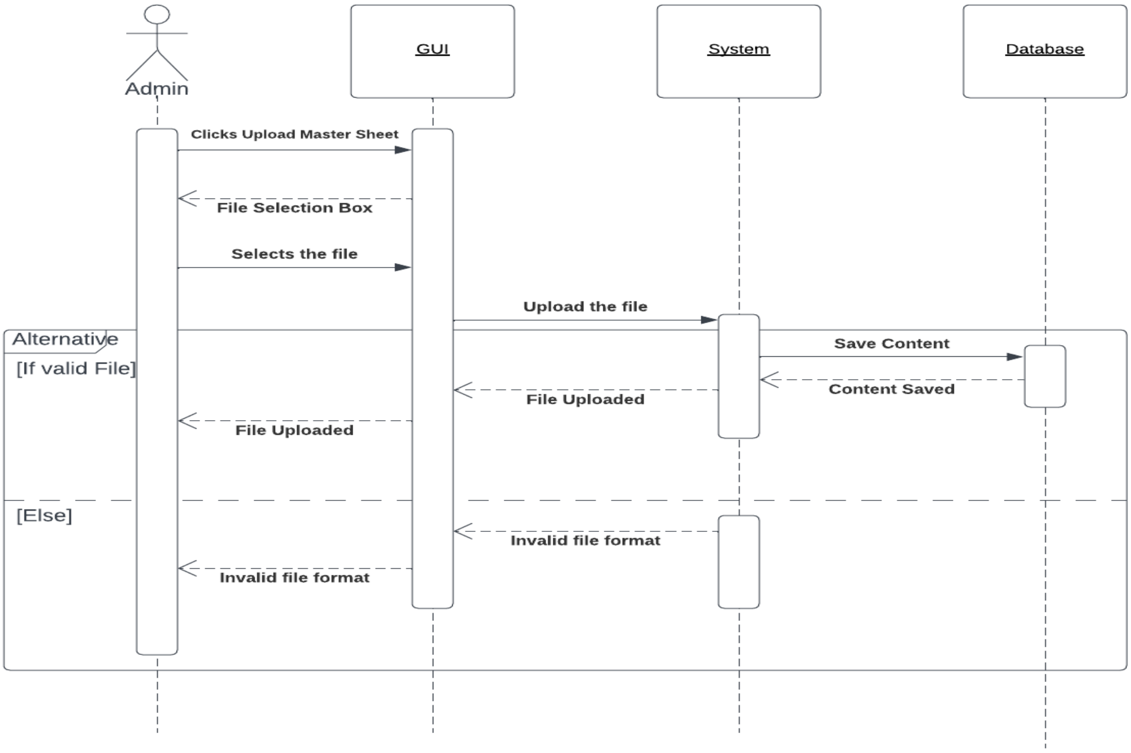


Figure 18: Login Sequence Diagram
The figure shows the sequence diagram of Login Function

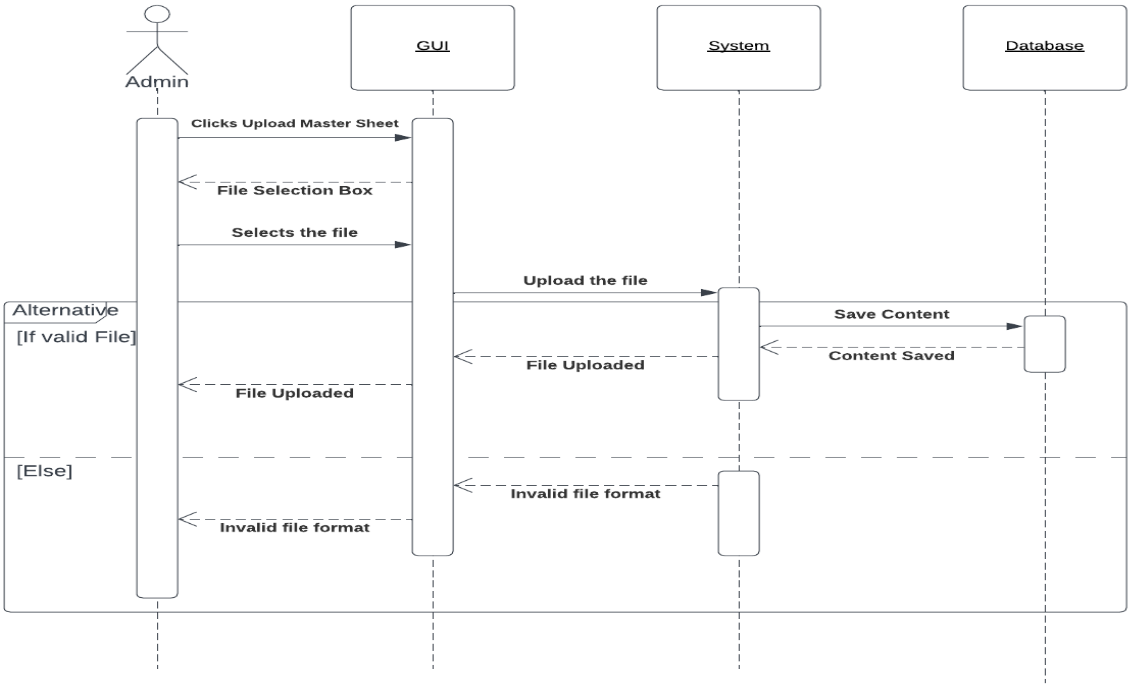


Figure 19: Upload Master Sheet Sequence Diagram
The figure shows the sequence diagram of Upload Master Sheet Function

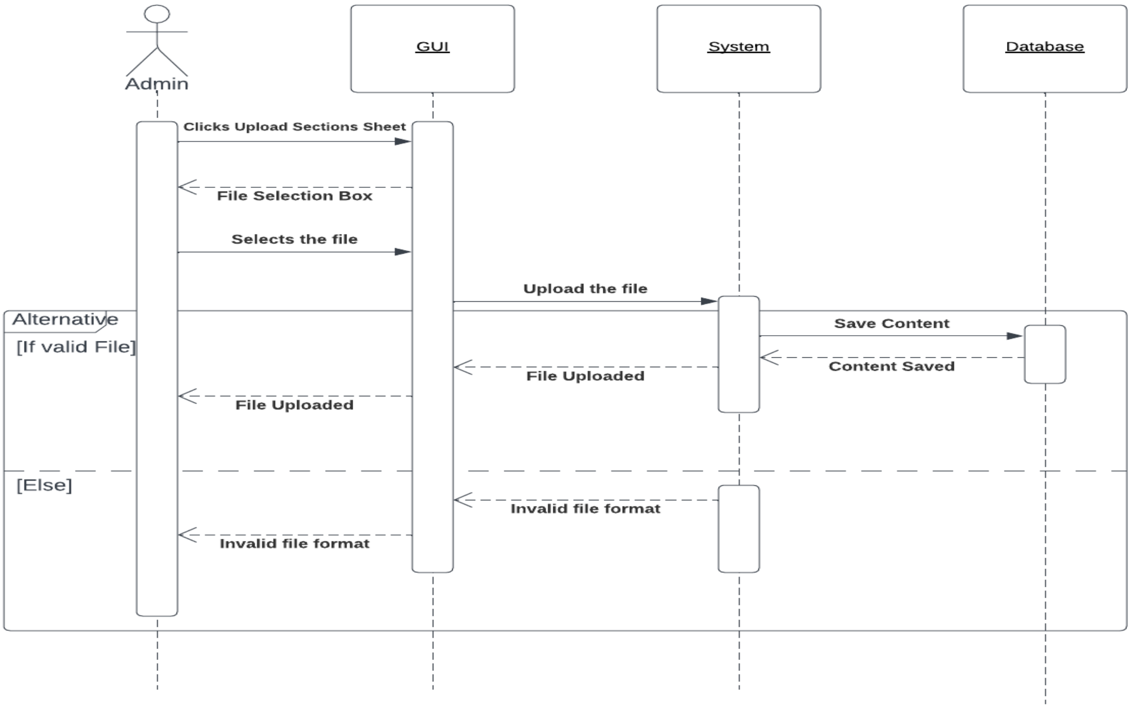


Figure 20: Upload Sections Sheet Sequence Diagram
The figure shows the sequence diagram of Upload Sections Sheet Function

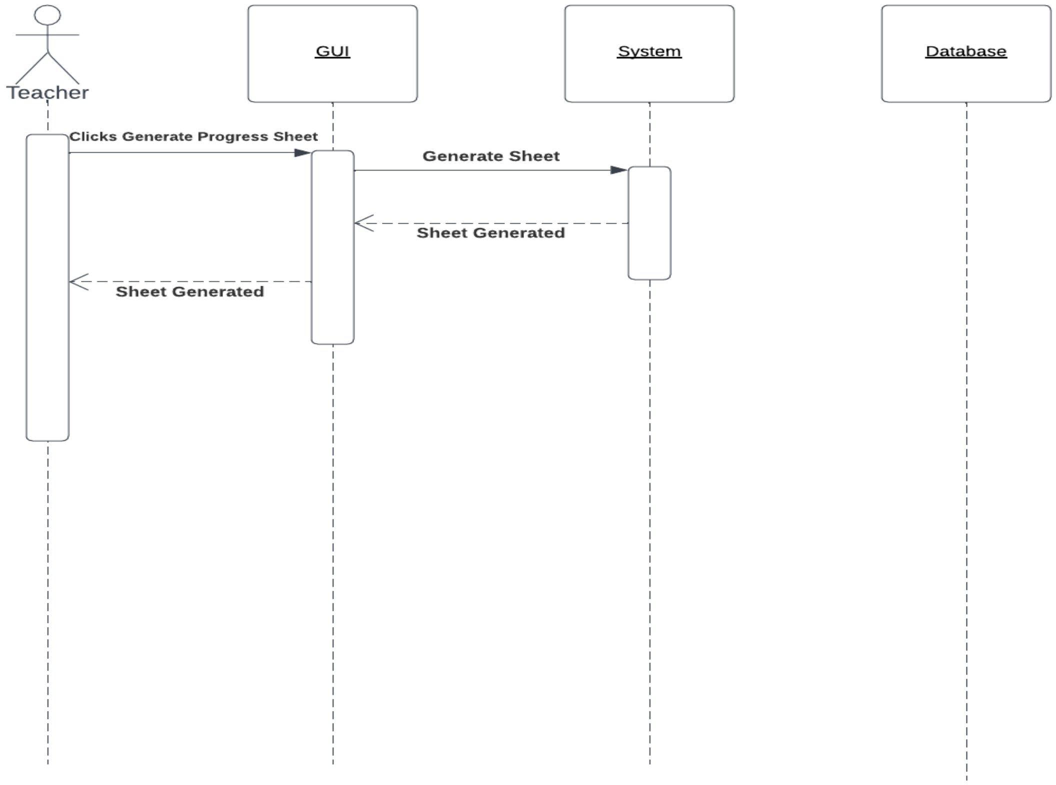


Figure 21: Generate Progress Sheet Sequence Diagram
The figure shows the sequence diagram of Generate Progress Sheet Function

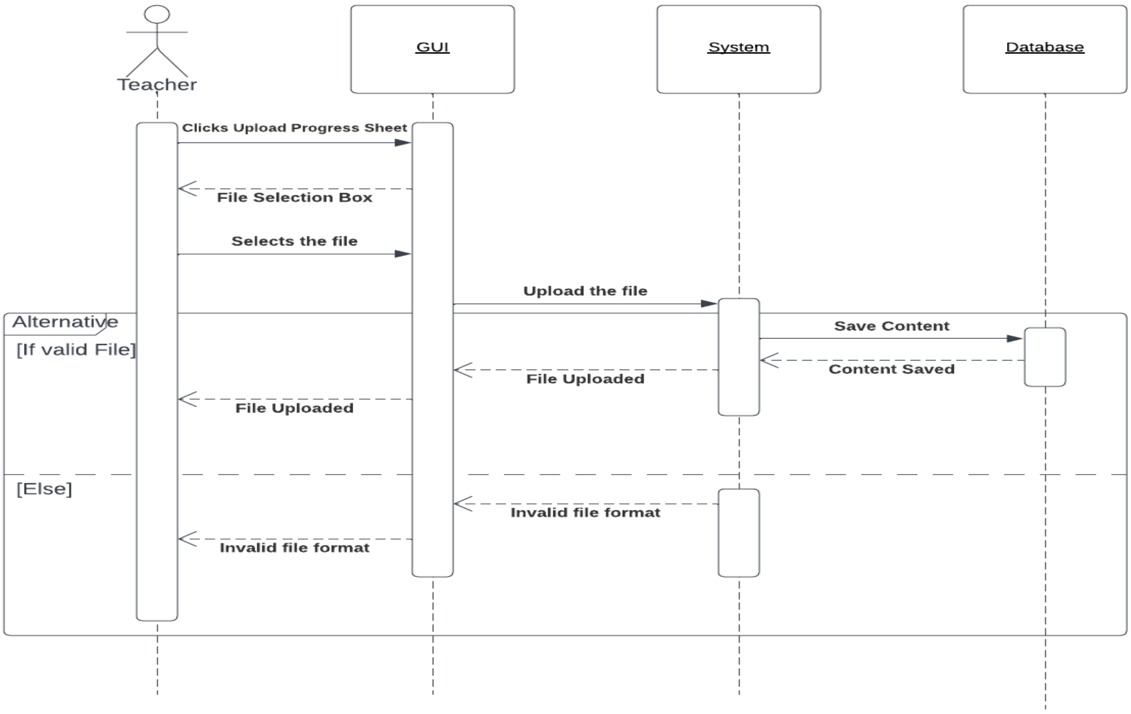


Figure 22: Upload Progress Sheet Sequence Diagram
The figure shows the sequence diagram of Upload Progress Sheet Function

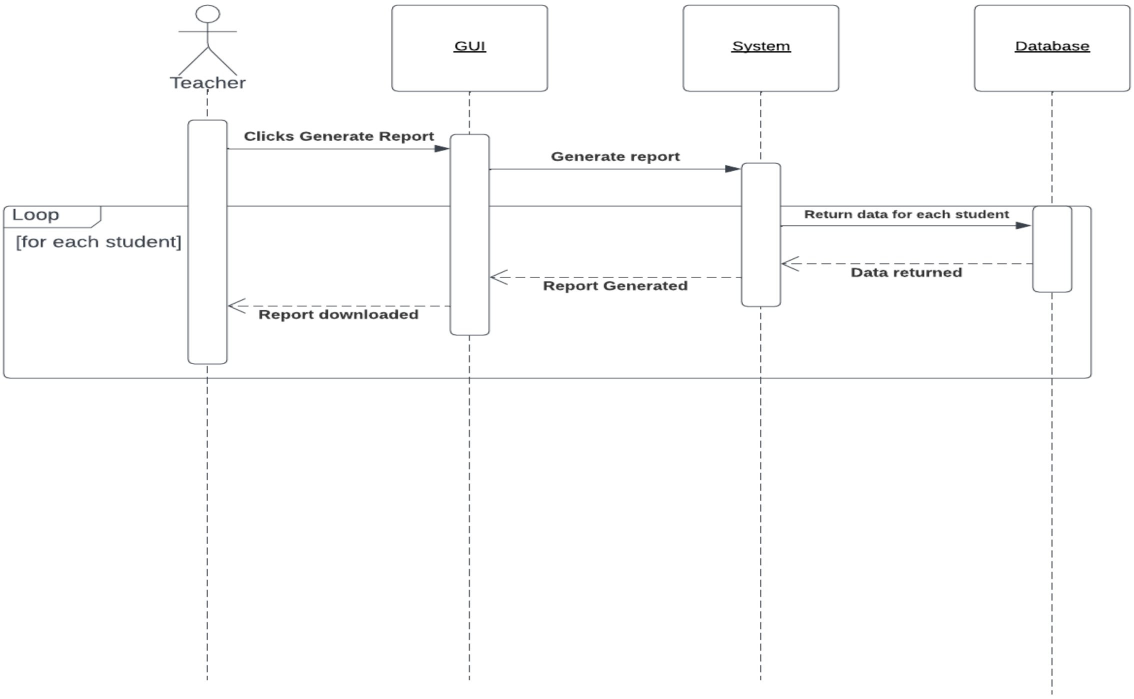


Figure 23: Generate Report Card Sequence Diagram
The figure shows the sequence diagram of Generate Report Card Function

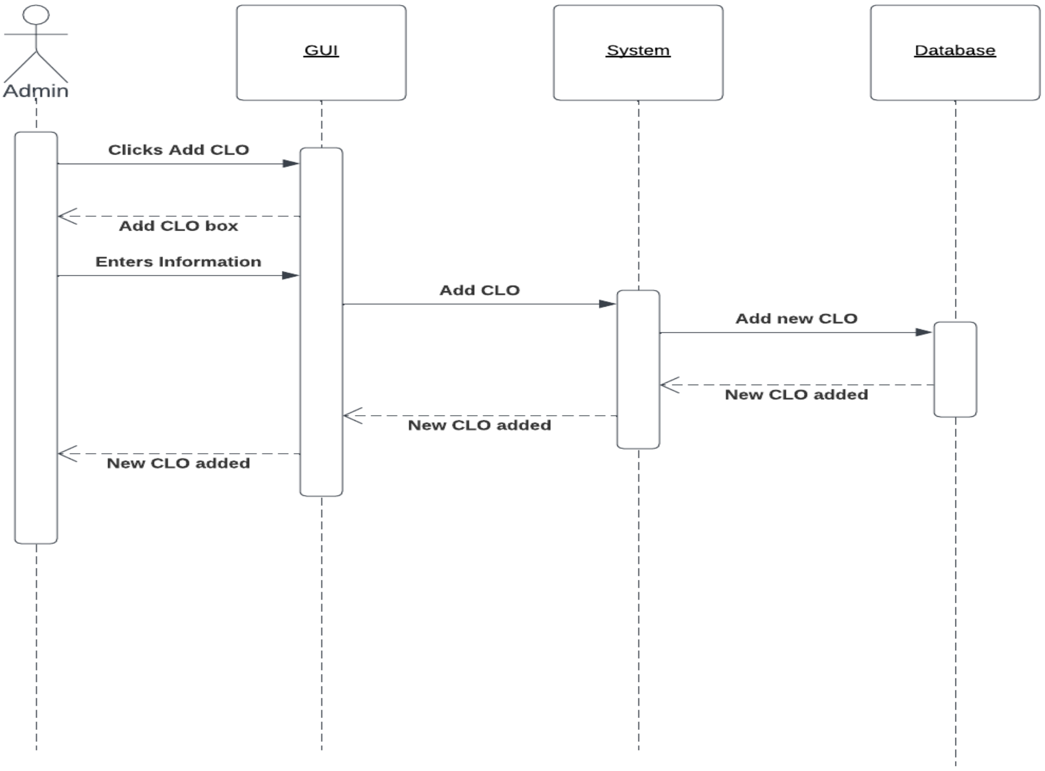


Figure 24: Add CLO Sequence Diagram
The figure shows the sequence diagram of Add CLO Function

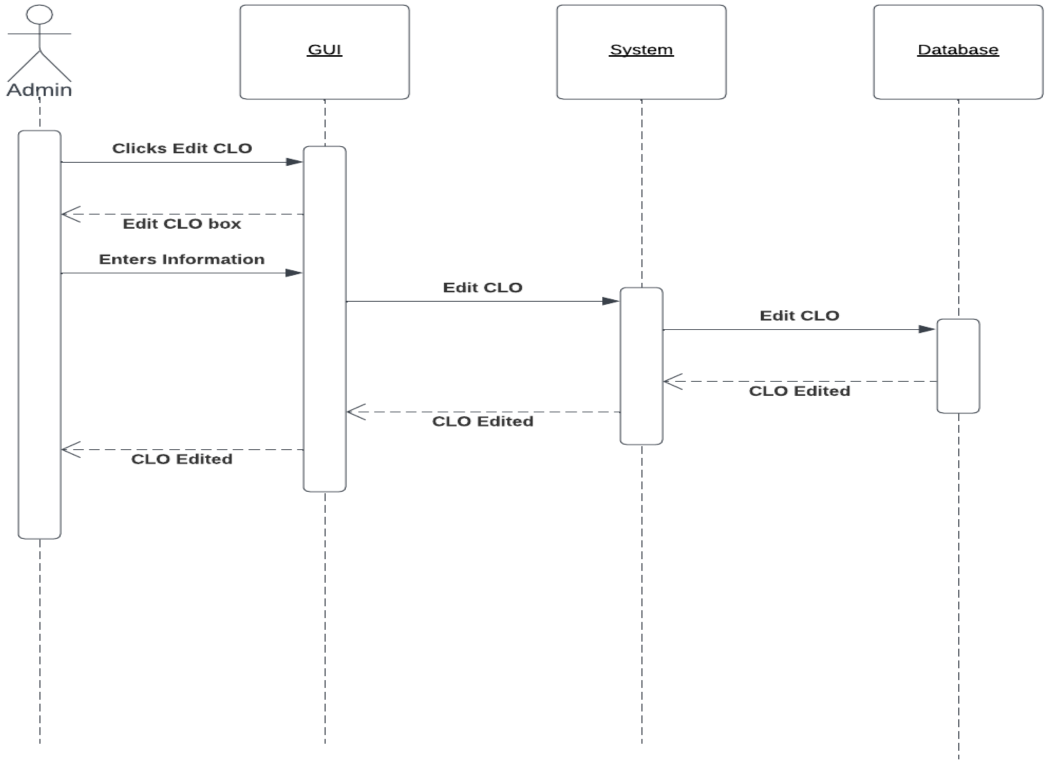


Figure 25: Edit CLO Sequence Diagram
The figure shows the sequence diagram of Edit CLO Function

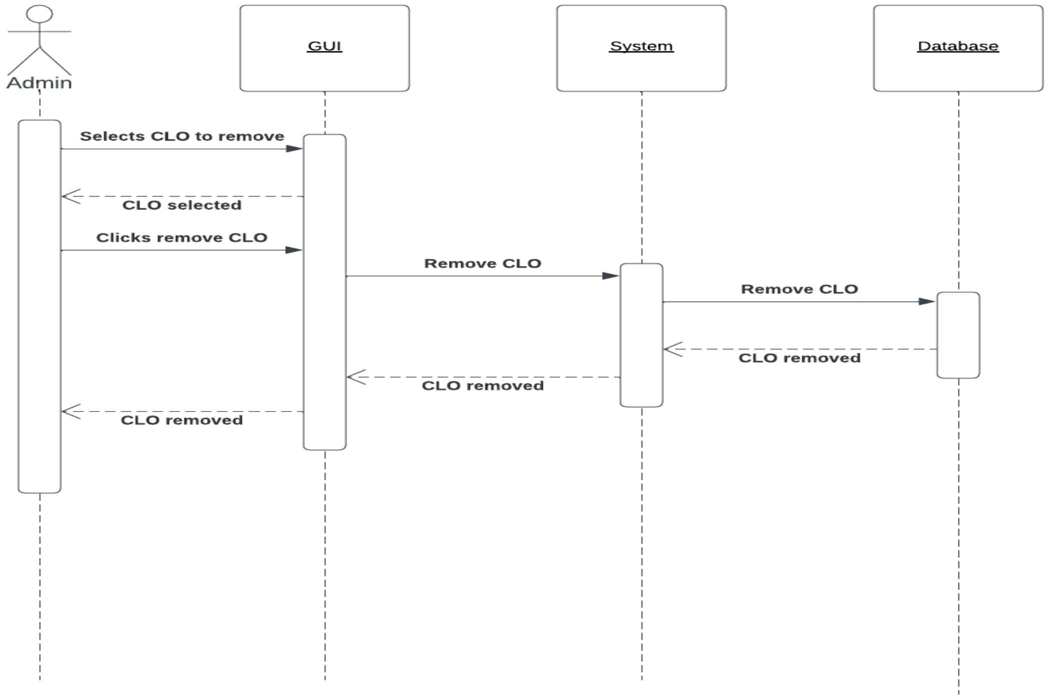


Figure 26: Remove CLO Sequence Diagram
The figure shows the sequence diagram of Remove CLO Function

5.7 Policies and Tactics

5.7.1 Choice of Specific Product to Be Used

Software specifications required for this system to work include Visual Studio Code, PyCharm, Microsoft Excel or any alternative.

5.7.2 Engineering Trade-offs

The scrum model was our choice. The scrum model's productivity and quality in terms of development are reasons to use it. Scrum is an agile methodology for developing, delivering, and managing complex software products.

5.7.3 Data Collection

The data of Civil Engineering students of Fast Lahore will be used.

5.7.4 Coding Guidelines and Conventions

For our system coding guidelines for React and Python will be followed as we will be using React for UI and Python as the main programming language.

5.7.5 Plans for Ensuring Requirements Traceability

As we have defined all the functional and non-functional requirements that the system is supposed to perform, we can create a requirement traceability matrix and ensure that all the requirements of the system are fulfilled.

5.7.6 Room for Extension

The system will be open to multiple extensions planned down the road and it will be highly scalable so it would be designed to accommodate changes later.

5.7.7 Plans for Testing

As the modules of the system will be completed one by one, they will be unit tested to ensure their proper working and that they are fulfilling the requirements that are expected from them. Later, while integrating these modules integration testing will be performed to test the modules perform optimally with each other. Load testing of the system will be done to check how system performs when multiple users are accessing it at a time.

5.7.8 Plans for Maintaining the Software

After deployment user feedback can be taken from the admin and teachers to check for improvement of system in any way possible (performance, visual improvements or addition of some feature).

5.7.9 Hierarchical Organization of the Source Code

The source code will be divided based on modules and can have different files and directories. This will help with the extendibility of the code as well because adding a new module would not require changes to existing ones.

Chapter 6: Implementation and Test Cases

The features that we implemented for our prototype include the front-end side using React and the backend side using Django. The features include the implementation of the login page, master sheet upload page, section sheet upload page, progress sheet download page, final sheet upload page and result card generation page. The feature implemented on the backend side includes the user authentication.

6.1 Implementation

The implementation of each feature is discussed below.

6.1.1 Login Page

This page includes two input fields for the login process. The two input fields are username and password. After providing the correct information the user is redirected to the next page.

6.1.2 Master Sheet Upload Page

This page includes an option to upload an excel sheet which is called the master sheet. After uploading the sheet user can see the CLOs for any course by selecting the semester number and the course name from two dropdown menus.

6.1.3 Section Sheet Upload Page

This page includes an option to upload an excel sheet which is called the section sheet. After uploading the sheet user can see the sections for each course using dropdown menus.

6.1.4 Progress Sheet Download Page

This page includes a table where each row shows the information regarding the course and section for the teacher, and it also contains an option to download a progress sheet for that section.

6.1.5 Final Sheet Upload Page

This page includes an option to upload the final progress sheet containing the evaluations for the section.

6.1.6 Result Card Generation Page

This page includes an option to generate the result cards for each student of a section.

6.1.7 User Authentication

User Authentication feature is implemented in the backend side which takes the login information from the login page and returns the user information if the user exists or return an error.

6.2 Test Case Diagram and Description

6.2.1 Login Test case

Table 19: Login Test Case
The description of the login test case

Login Module			
Test Case ID:	*T1*	**QA Test Engineer:**	*Faiza Azam*
Test case Version:	*1.1*	**Reviewed By:**	*Ahsan Mehmood*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*User Login*
Revision History:	*None*		
Objective	*To check if User is able to successfully login to the website.*		
Product/Ver/Module:	*Website Login Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*Login button is visible to user.*		
Pre-Requisite:	*The user is store in database and registered as a valid user.*		
Step No.	**Execution description**	**Procedure result**	
1	*Users click on Log In button.*	*System displays the Login page.*	
2	*Users enter their credentials, i.e. Their username and password click Login.*	System take user to their Profile.	
Comments: **The test case is passed. Our system works according to our need**			
☑*Passed* □*Failed* □*Not Executed*			

6.2.2 Logout Test case

Table 20: Logout Test Case
The description of the logout test case

Logout Module			
Test Case ID:	*T2*	**QA Test Engineer:**	*Faiza Azam*
Test case Version:	*2.1*	**Reviewed By:**	*Ahsan Mehmood*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Logout*
Revision History:	*None*		
Objective	*To check if system is successfully logout.*		
Product/Ver/Module:	*Logout Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*Logout option is visible.*		
Pre-Requisite:	*The user is logged in.*		
Step No.	**Execution description**	**Procedure result**	
1	*User clicks on logout button.*	*System redirect user to home page.*	

Comments: **The test case is passed. Our system works according to our need**
● *Passed* □ *Failed* □ *Not Executed*

6.2.3 Upload Master Sheet Test case

Table 21: Upload Master Sheet Test Case

The description of the upload master sheet test case

Admin Module			
Test Case ID:	*T3*	**QA Test Engineer:**	*Faiza Azam*
Test case Version:	*3.1*	**Reviewed By:**	*Ahsan Mehmood*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Upload Master Sheet*
Revision History:	*None*		
Objective	*To check if master sheet is uploaded successfully and contents are saved in database*		
Product/Ver/Module:	*Admin Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*Upload button is visible to the admin*		
Pre-Requisite:	*The admin is logged in.*		
Step No.	**Execution description**	**Procedure result**	
1 **2**	*User clicks on Upload Master Sheet button.* *User selects the master sheet to upload*	*System displays a box to the user which lets the user select the required file.* *Data is saved to the database and system display success message.*	
Comments: **The test case is passed. Our system works according to our need**			
● *Passed* □ *Failed* □ *Not Executed*			

6.2.4 Upload Section Sheet Test case

Table 22: Upload Section Sheet Test Case

The description of the upload section sheet test case

Admin Module			
Test Case ID:	*T4*	**QA Test Engineer:**	*Faiza Azam*
Test case Version:	*4.1*	**Reviewed By:**	*Ahsan Mehmood*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Upload Section Sheet*
Revision History:	*None*		
Objective	*To check if section sheet is uploaded successfully and contents are saved in database*		
Product/Ver/Module:	*Admin Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*Upload button is visible to the admin*		
Pre-Requisite:	*The admin is logged in.*		

Step No.	**Execution description**	**Procedure result**
1 **2**	*User clicks on Upload Section Sheet button.* *User selects the section sheet to upload*	*System displays a box to the user which lets the user select the required file.* *Data is saved to the database and system display success message.*
Comments: **The test case is passed. Our system works according to our need**		
● *Passed* □ *Failed* □ *Not Executed*		

6.2.5 Update Master Sheet Test case

Table 23: Update Master Sheet Test Case

The description of the update master sheet test case

Admin Module			
Test Case ID:	*T5*	**QA Test Engineer:**	*Faiza Azam*
Test case Version:	*5.1*	**Reviewed By:**	*Ahsan Mehmood*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Update Master Sheet*
Revision History:	*None*		
Objective	*To test update master sheet functionality*		
Product/Ver/Module:	*Admin Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*None*		
Pre-Requisite:	*The admin is logged in and master sheet is uploaded.*		
Step No.	**Execution description**	**Procedure result**	
1 **2**	*User clicks on edit master sheet button.* *User edits the data uploaded by sheet.*	*System lets the user select the fields to edit.* *Data is saved to the database and system display success message.*	
Comments: **The test case is passed. Our system works according to our need**			
● *Passed* □ *Failed* □ *Not Executed*			

6.2.6 Update Section Sheet Test case

Table 24: Update Section Sheet Test Case

The description of the update section sheet test case

Admin Module			
Test Case ID:	*T6*	**QA Test Engineer:**	*Faiza Azam*
Test case Version:	*6.1*	**Reviewed By:**	*Ahsan Mehmood*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Update Section Sheet*
Revision History:	*None*		
Objective	*To test update section sheet functionality*		

Product/Ver/Module:	*Admin Module.*	
Environment:	*The website is up and running and system is online.*	
Assumptions:	*None*	
Pre-Requisite:	*The admin is logged in and section sheet is uploaded.*	
Step No.	**Execution description**	**Procedure result**
1 **2**	*User clicks on edit section sheet button.* *User edits the data uploaded by sheet.*	*System lets the user select the fields to edit.* *Data is saved to the database and system display success message.*
Comments: **The test case is passed. Our system works according to our need**		
● *Passed* □ *Failed* □ *Not Executed*		

6.2.7 Download Progress Sheet Test Case

Table 25: Download Progress Sheet Test Case
The description of the download progress sheet test case

Admin Module			
Test Case ID:	*T7*	**QA Test Engineer:**	*Ahsan Mehmood*
Test case Version:	*7.1*	**Reviewed By:**	*Faiza Azam*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Download Progress Sheet*
Revision History:	*None*		
Objective	*To test download progress sheet functionality*		
Product/Ver/Module:	*Teacher Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*None*		
Pre-Requisite:	*The admin must be logged in and assigned a section.*		
Step No.	**Execution description**	**Procedure result**	
1	*User(teacher) clicks on download progress sheet button.*	*System lets the user download the sheet and save to their device.*	
Comments: **The test case is passed. Our system works according to our need**			
● *Passed* □ *Failed* □ *Not Executed*			

6.2.8 Upload Final Progress Sheet Test Case

Table 26: Upload Final Sheet Test Case
The description of the upload final sheet test case

Admin Module			
Test Case ID:	*T8*	**QA Test Engineer:**	*Ahsan Mehmood*
Test case Version:	*8.1*	**Reviewed By:**	*Faiza Azam*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Upload Final Progress Sheet*

Revision History:	*None*	
Objective	*To test upload master sheet functionality*	
Product/Ver/Module:	*Teacher Module.*	
Environment:	*The website is up and running and system is online.*	
Assumptions:	*None*	
Pre-Requisite:	*The teacher must have downloaded the progress sheet.*	
Step No.	**Execution description**	**Procedure result**
1 **2**	*User clicks on upload progress sheet button.* *User selects the file to upload to the system.*	*System displays a box to the user which lets the user select the required file.* *Data is saved to the database and system display success message.*
Comments: **The test case is passed. Our system works according to our need**		
☑*Passed* ☐*Failed* ☐*Not Executed*		

6.2.9 Generate Report Card Test Case

Table 27: Generate Report Card Test Case
The description of the generate report card test case

Admin Module			
Test Case ID:	*T9*	**QA Test Engineer:**	*Ahsan Mehmood*
Test case Version:	*9.1*	**Reviewed By:**	*Faiza Azam*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Generate Report Card*
Revision History:	*None*		
Objective	*To test generate report card functionality*		
Product/Ver/Module:	*Teacher Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*None*		
Pre-Requisite:	*A final completed sheet must be uploaded to the system by the teacher.*		
Step No.	**Execution description**	**Procedure result**	
1	*User clicks on generate report card button.*	*The report cards are generated by the system.*	
Comments: **The test case is passed. Our system works according to our need**			
☑*Passed* ☐*Failed* ☐*Not Executed*			

6.2.10 Display Statistics Test Case

Table 28: Display Statistics Test Case
The description of the display statistics test case

Admin Module			
Test Case ID:	*T10*	**QA Test Engineer:**	*Ahsan Mehmood*
Test case Version:	*10.1*	**Reviewed By:**	*Faiza Azam*

Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Display Statistics*
Revision History:	*None*		
Objective	*To test display statistics functionality*		
Product/Ver/Module:	*Teacher Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*None*		
Pre-Requisite:	*A final completed sheet must be uploaded to the system by the teacher.*		
Step No.	**Execution description**	**Procedure result**	
1	*User clicks on the view statistics button.*	*System generates the reports regarding the statistics.*	
Comments: **The test case is passed. Our system works according to our need**			
☑*Passed* □*Failed* □*Not Executed*			

6.2.11 Generate Graphs Test Case

Table 29: Generate Graphs Test Case

The description of the generate graphs test case

Admin Module			
Test Case ID:	*T11*	**QA Test Engineer:**	*Ahsan Mehmood*
Test case Version:	*11.1*	**Reviewed By:**	*Faiza Azam*
Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Generate Graphs*
Revision History:	*None*		
Objective	*To test update master sheet functionality*		
Product/Ver/Module:	*Admin Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*None*		
Pre-Requisite:	*A final completed sheet must be uploaded to the system by the teacher.*		
Step No.	**Execution description**	**Procedure result**	
1	*The teacher clicks the view statistics button.*	*The graphs regarding the statistics are generated.*	
Comments: **The test case is passed. Our system works according to our need**			
☑*Passed* □*Failed* □*Not Executed*			

6.2.12 Future Prediction Test Case

Table 30: Future Prediction Test Case

The description of the future prediction test case

Admin Module			
Test Case ID:	*T12*	**QA Test Engineer:**	*Ahsan Mehmood*
Test case Version:	*12.1*	**Reviewed By:**	*Faiza Azam*

Test Date:	*20/11/2023*	**Use Case Reference(s):**	*Future Prediction*
Revision History:	*None*		
Objective	*To test update master sheet functionality*		
Product/Ver/Module:	*Admin Module.*		
Environment:	*The website is up and running and system is online.*		
Assumptions:	*None*		
Pre-Requisite:	*A final completed sheet must be uploaded to the system by the teacher.*		
Step No.	**Execution description**	**Procedure result**	
1	*The teacher clicks the generate report card button.*	*The report cards are generated with the future prediction by the system.*	
Comments: **The test case is passed. Our system works according to our need**			
●*Passed* □*Failed* □*Not Executed*			

6.3 Test Metrics

Following are some test case metrics for our project.

6.3.1 Test case Matric.No.1

Table 31: Test Case Metrics

Metric	**Purpose**
Number of Test Cases	12
Number of Test Cases Passed	12
Number of Test Cases Failed	0
Test Case Defect Density	0/12
Test Case Effectiveness	12/12

Chapter 7: User Manual

This section provides guidelines and instructions for the proper use of the system that has been developed and shall serve the purpose of a user manual. The manual contains instructions ranging from the installation and setup of local development environment to the usage of the website depending on the role of the user.

7.1 Installation & Setup

To launch the system locally for development purposes, following prerequisites & dependencies must be installed on the computer.

- Node JS
- React
- Mozilla Firefox/Google Chrome
- Django
- Python

7.2 Admin

Few guidelines for Admin to getting started with the website are listed below:

7.2.1 Getting Started

To get started with the Automated Recruitment System, follow these steps:

- Go to the website's homepage.
- Login with your email and password on the login page.

7.2.2 Upload Master Sheet

- Make use of your username and password to log in to your account.
- You'll be taken to your admin’s home page once you log in.
- Find the "Upload Master Sheet" button on the admin’s home page.
- When you click on the "Upload Master Sheet" button. A box will open which will let the user select the required file.
- When you select the required file click on “confirm” button. The file will be uploaded, and the system will prompt a success message letting you know that your sheet has been successfully uploaded after the upload procedure is finished.

7.2.3 Upload Section Sheet

- Make use of your username and password to log in to your account.
- You'll be taken to your admin’s home page once you log in.
- Find the "Upload Section Sheet" button on the admin’s home page.
- When you click on the "Upload Section Sheet" button. A box will open which will let the user select the required file.
- When you select the required file click on “confirm” button. The file will be uploaded, and the system will prompt a success message letting you know that your sheet has been successfully uploaded after the upload procedure is finished.

7.2.4 Update Master Sheet

- Make use of your email address and password to log in to your account. Ensure that the master sheet you want to update has already been uploaded.
- Click on the edit master sheet button.
- “Edit Information” dialogue box will appear, enter the required course name, CLO and PLO name in the fields respectively.
- Click on the confirm button to confirm the changes.
- The system will display a success message after the updating procedure is complete.

7.2.5 Update Section Sheet

- Make use of your email address and password to log in to your account. Ensure that the section sheet you want to update has already been uploaded.
- Click on the edit section sheet button.
- “Edit Information” dialogue box will appear, enter the required course code, course name and semester number in the respective fields.
- Click on the confirm button to confirm the changes.
- The system will display a success message after the updating procedure is complete.

7.2.6 Download Progress Sheet

- Make use of your email address and password to log in to your account.
- Select the section you want to download progress sheet of.
- Click on the generate sheet button.
- The system will provide you with a progress sheet file.
- Download that file into your computer.

7.2.7 Upload Final Progress Sheet

- Make use of your email address and password to log in to your account.
- Select the section you want to upload the progress sheet of.
- Click on the upload sheet button.
- The system will provide you with prompt to select a progress sheet file.
- Select the file from your computer.

7.2.8 Generate Report Card

- Make use of your email address and password to log in to your account.
- Select the section you want to generate the report card of.
- Click on the generate report card button.
- The system will generate a report card for each student based on the final progress sheet.

7.2.9 Display Statistics

- Make use of your email address and password to log in to your account.
- Select the section you want to generate the report card of.
- Click on the display statistics button.

- The system will generate reports which contain different statistics for the teacher.

7.2.10 Generate Graphs

- Make use of your email address and password to log in to your account.
- Select the section you want to generate the report card of.
- Click on the display statistics button.
- The system will generate graph based on different statistics for the teacher.

7.2.11 Future Prediction

- Make use of your email address and password to log in to your account.
- Select the section you want to generate the report card of.
- Click on the display statistics button.
- The system will generate report card along with future prediction for the teacher.

Chapter 8: Conclusion and Future Work

Our project is about an intelligent system that can track CLOs and PLOs, generate results, and guide the students for their academic improvements. Outcome-Based-Education is getting more and more famous these days and institutions in Pakistan are now advised by the Professional bodies to move from traditional education to OBE. Our system includes all the necessary features to assist the teachers in evaluating their students based on their outcomes and more. The work done so far includes the development of the client side of the project, which includes the development of all the pages. On the server-side user authentication mechanism was implemented. The admin side services like master sheet upload and section sheet upload are fully functional and are very easy to use and understand. The teacher side services are also fully functional which allows the teacher to download progress sheets for the entire semester. After their evaluations they can again upload the sheets to the system and can update the results and download them. Our system allows includes a future prediction feature that can predict the future result of the students and can guide them early to improve the results where necessary. The future work for this project includes running different test cases and improving the overall performance of the system.

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