

CSE201: Advanced Programming

Project: University ERP

Documentation

27 November, 2025

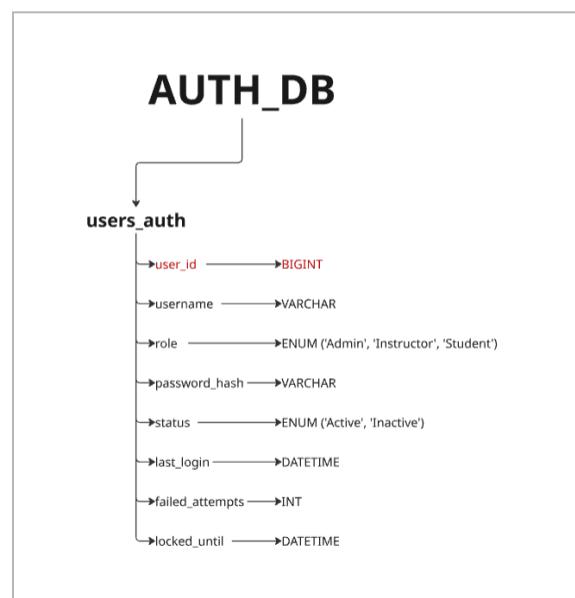
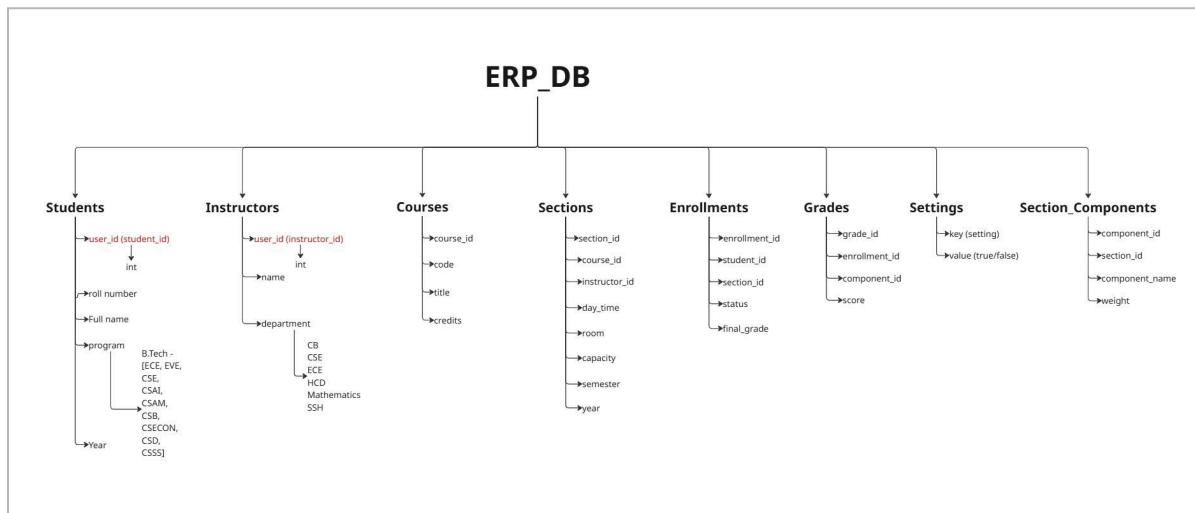
Group 27

Group 27 Team Members:

1. Evani Menon (2024210)
2. Nandika Routray (2024371)

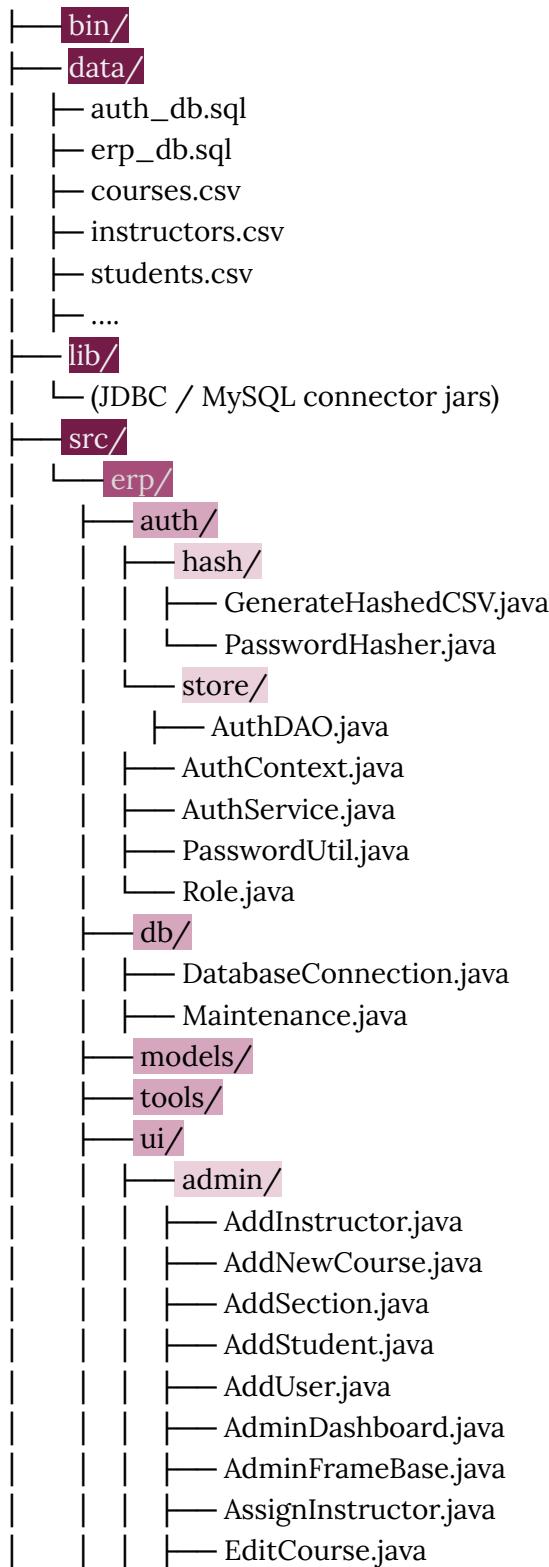
Database Layout & Implementation:

- We collaboratively used Miro to determine the exact structure of the databases and tables to implement.
- MySQL was used for all database implementations.



Directory Structure:

IIITD-ACADEMIC-ERP



```
    |   |   ├── EditExistingCourses.java
    |   |   ├── EditSectionDetails.java
    |   |   ├── EditSections.java
    |   |   ├── ManageCourses.java
    |   |   └── instructor/
    |   |       ├── EditComponents.java
    |   |       ├── GradeStudents.java
    |   |       ├── InstructorDashboard.java
    |   |       ├── InstructorFrameBase.java
    |   |       ├── ManageComponents.java
    |   |       └── MySections.java
    |   |   └── student/
    |   |       ├── CourseCatalog.java
    |   |       ├── CourseSectionsDialog.java
    |   |       ├── EnrollmentService.java
    |   |       ├── GradesDialog.java
    |   |       ├── MyRegistrationsFrame.java
    |   |       ├── StudentDashboard.java
    |   |       ├── StudentFrameBase.java
    |   |       ├── StudentLookupService.java
    |   |       ├── StudentTimetableFrame.java
    |   |       └── TranscriptExporter.java
    |   |   └── assets/
    |   |   └── auth/
    |   |       ├── ChangePassword.java
    |   |       └── LoginPage.java
    |   └── Main.java
resources/
.gitignore
APM25 Guidelines.pdf
files.txt
README.md
sources.txt
```

Use Case Lists:

1. Admin:

- Add/edit courses
- Add/edit sections
- Add instructors
- Add students
- Delete users
- Toggle maintenance mode

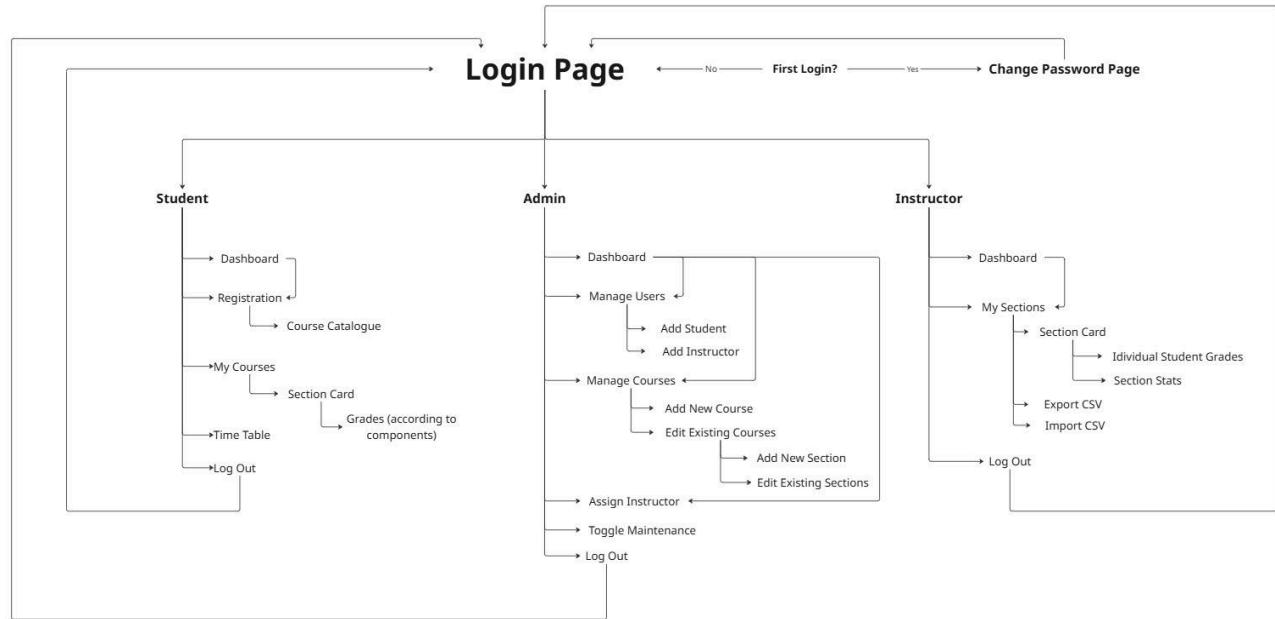
2. Instructor

- View assigned sections
- Edit assessment components
- Enter student grades (CSV or manual)
- Export CSV file of student grades
- View all student grades in all sections
- View class statistics

3. Student

- View course catalogue
- Register for courses (before add/drop deadline)
- Drop courses (before add/drop deadline)
- View timetable/class schedule
- View grades in each component for all registered courses
- View final grades

UI Screens Layout:



Final-Grade Weighting Implementation:

- Each student enrolling for a course is stored in the 'enrollments' table. Each student registering for a particular course section has a unique enrollment_id.

```
mysql> describe enrollments;
+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default |
+-----+-----+-----+-----+-----+
| enrollment_id | int | NO | PRI | NULL |
| student_id | varchar(64) | NO | MUL | NULL |
| section_id | int | NO | MUL | NULL |
| status | enum('REGISTERED', 'DROPPED') | NO | | REGISTERED |
| final_grade | decimal(5,2) | YES | | NULL |
+-----+-----+-----+-----+-----+
5 rows in set (0.01 sec)
```

- Similarly, each student in a particular course section will get one final grade. This grade is also stored in the 'enrollments' table, mapped by the enrollment_id.

- A separate table ‘section_components’ has entries with unique ‘component_id’s as primary keys. It stores all the components along with their weightage for every section (identified by section_id).

```
mysql> describe section_components;
+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+
| component_id | int | NO | PRI | NULL | auto_increment |
| section_id | int | NO | MUL | NULL |
| component_name | varchar(100) | NO | | NULL |
| weight | int | NO | | NULL |
+-----+-----+-----+-----+
4 rows in set (0.01 sec)
```

- The ‘grades’ table utilises the enrollment_id from the enrollments table and the component_id from the section_components table to store individual grades for each student in every component across all their registered sections.

```
mysql> describe grades;
+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+
| grade_id | int | NO | PRI | NULL |
| enrollment_id | int | NO | MUL | NULL |
| component_id | int | NO | | NULL |
| score | decimal(5,2) | YES | | NULL |
+-----+-----+-----+-----+
4 rows in set (0.01 sec)
```

Final grade calculation rule:

For every component of a section, the system multiplies the **score obtained by the student** (entered by the instructor) with the **component weightage** (from the section_components table), and then sums all weighted values:

$$\text{Final Grade} = \sum (\text{score}_i \times \text{weight}_i)$$

This computation runs when the instructor submits grades.

After the calculation, the result is written back to the final_grade column in ‘enrollments’

Password Hashing & Authentication

- Passwords are never stored or compared in plain text.
- At account creation or password change, the application uses **BCrypt** to convert the user's password into a secure, irreversible hash.

BCrypt Features:

- It is one-way (you can't reverse it)
- It includes a salt automatically (prevents two identical passwords from producing the same hash)

```
String hashed = BCrypt.hashpw(plainPassword, BCrypt.gensalt(12));
```

- The plain password is never saved.
- gensalt(12) adds a random salt and sets the work factor to 12.

```
BCrypt.checkpw(enteredPassword, storedHash);
```

- During login, the entered password is hashed again and then compared to the stored hash.
- If the two hashes match → login succeeds.
Otherwise → login fails.
- If login fails more than 5 times, then the account is locked for 1 minute.

Sessions & Roles

After successful login, the system creates a session object containing:

- userId
- username
- role (STUDENT / INSTRUCTOR / ADMIN)

This session is stored in **AuthContext**, which is globally readable by all UI screens and service classes.

Before any user specific screen is opened, and before the corresponding backend action runs, the system checks the user's role. If the role does not match the allowed permissions for that feature, the UI refuses to open and the method returns without executing the

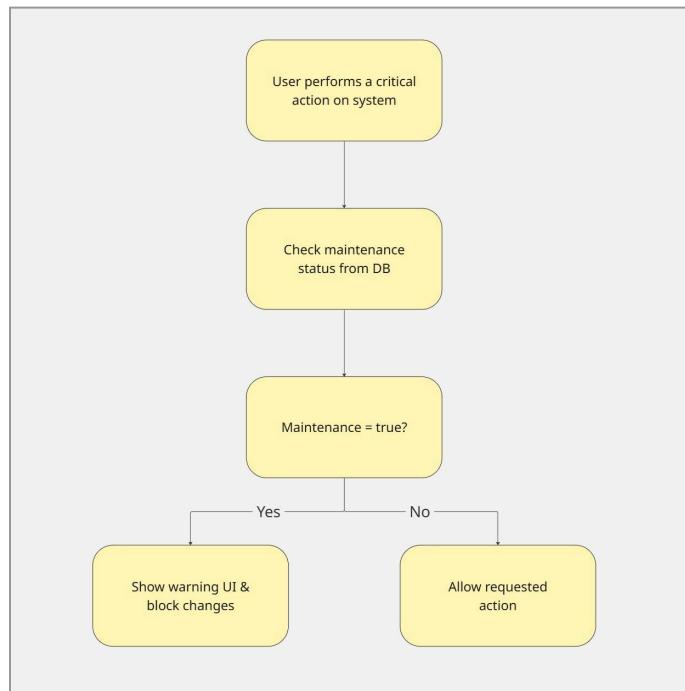
logic. So even if someone tries to bypass the interface or trigger actions/screens through terminal, the backend will block it.

So, all the use cases stay limited to only the relevant user.

Maintenance Mode Implementation

The 'settings' table stores global settings such as Add/Drop Deadline and Maintenance Mode Toggle. A boolean setting (setting_key = 'Maintenance') in the settings table controls whether the ERP should run normally or restrict activity.

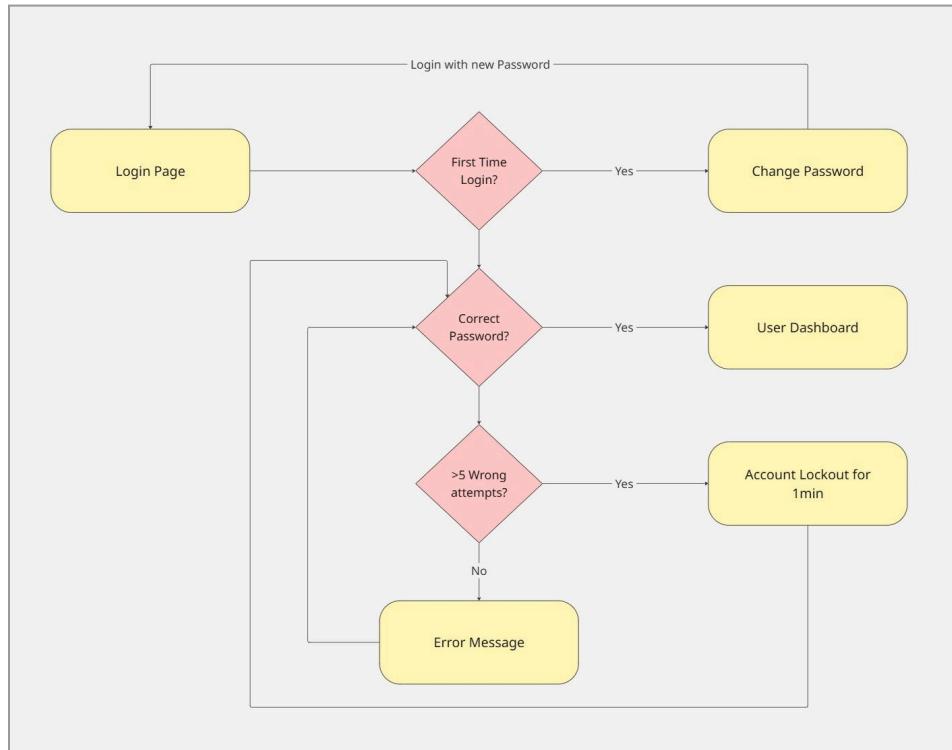
- At startup and during key operations, the system queries settings through Maintenance.isOn().
- If maintenance mode is ON, the UI displays a warning banner on the top of the page and blocks actions such as creation, update, and deletion. Users can only perform actions which are view-only.
- Admins can toggle the flag in the database using Maintenance.turnOn() and Maintenance.turnOff(). These methods update the database, making the change instant across all running clients since each screen re-checks maintenance state from the database before executing critical actions.



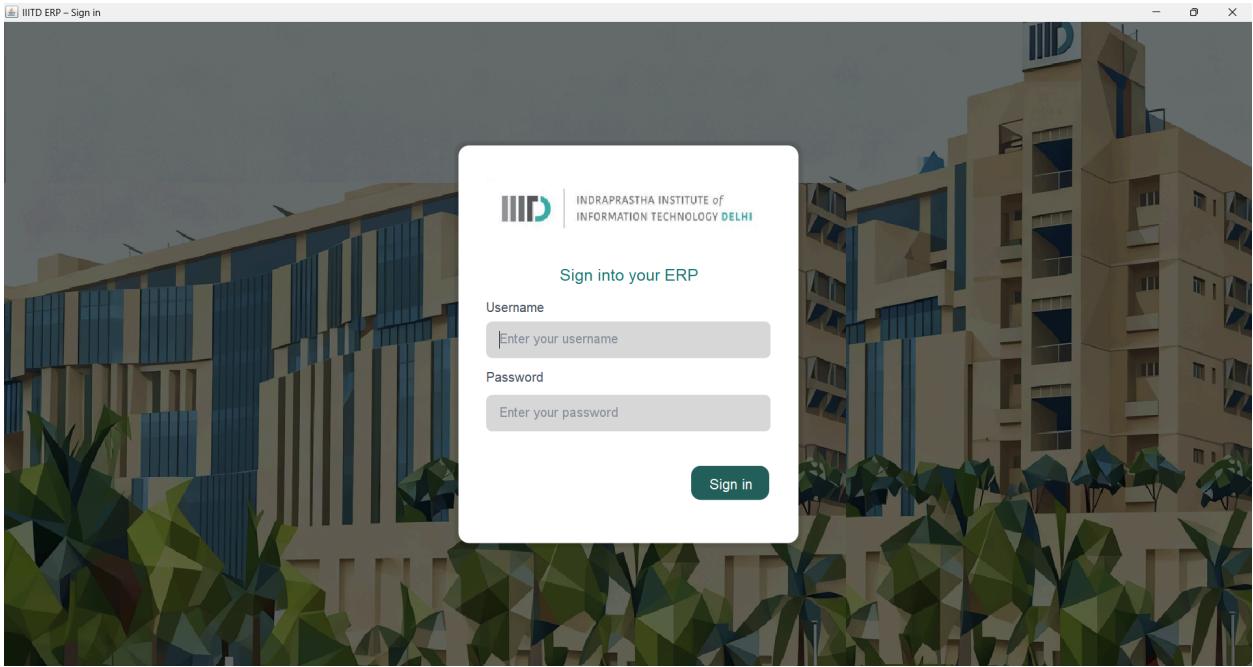
Tech Stack

Component	Implementation
UI	Java Swing
Database	MySQL
Connection Pooling	HikariCP
Password Hashing	BCrypt (via org.mindrot.jbcrypt)
Data Transfer	JDBC + PreparedStatement
Logging	java.util.logging
Files Import / Export	CSV → Table Bootstrap + Transcript Export

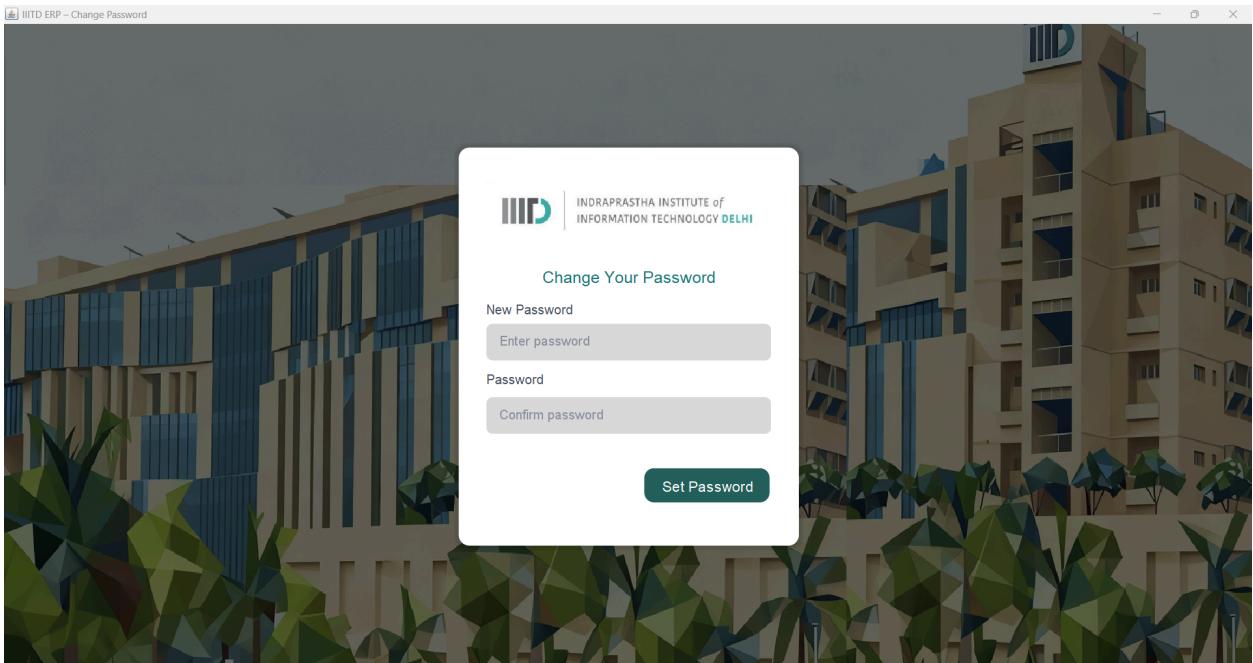
General UI Flow - Login



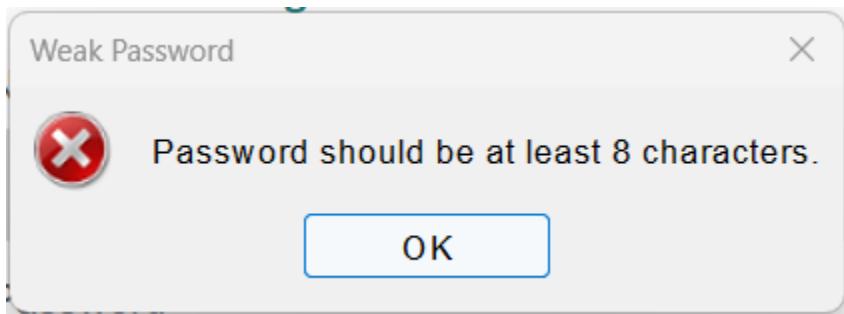
Login Page:



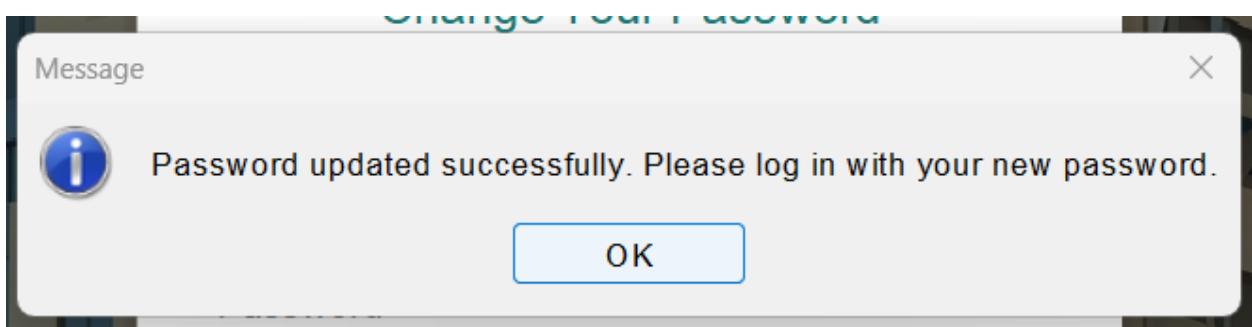
First Time Login:



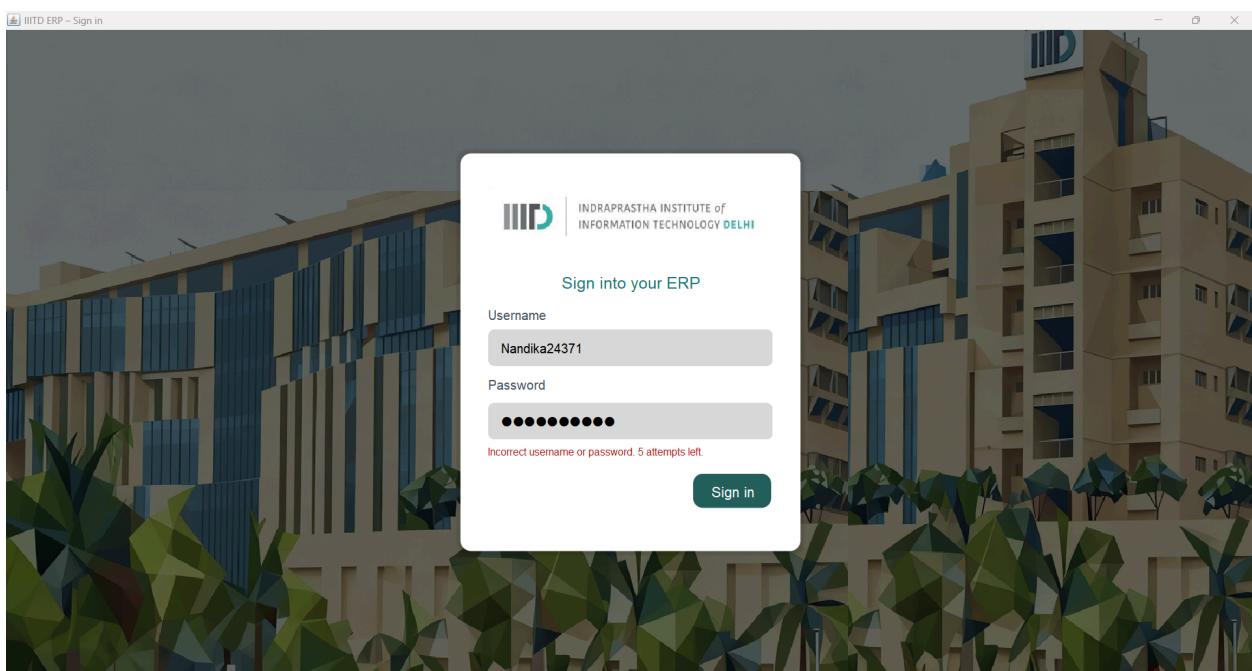
Password < 8 characters (weak password)



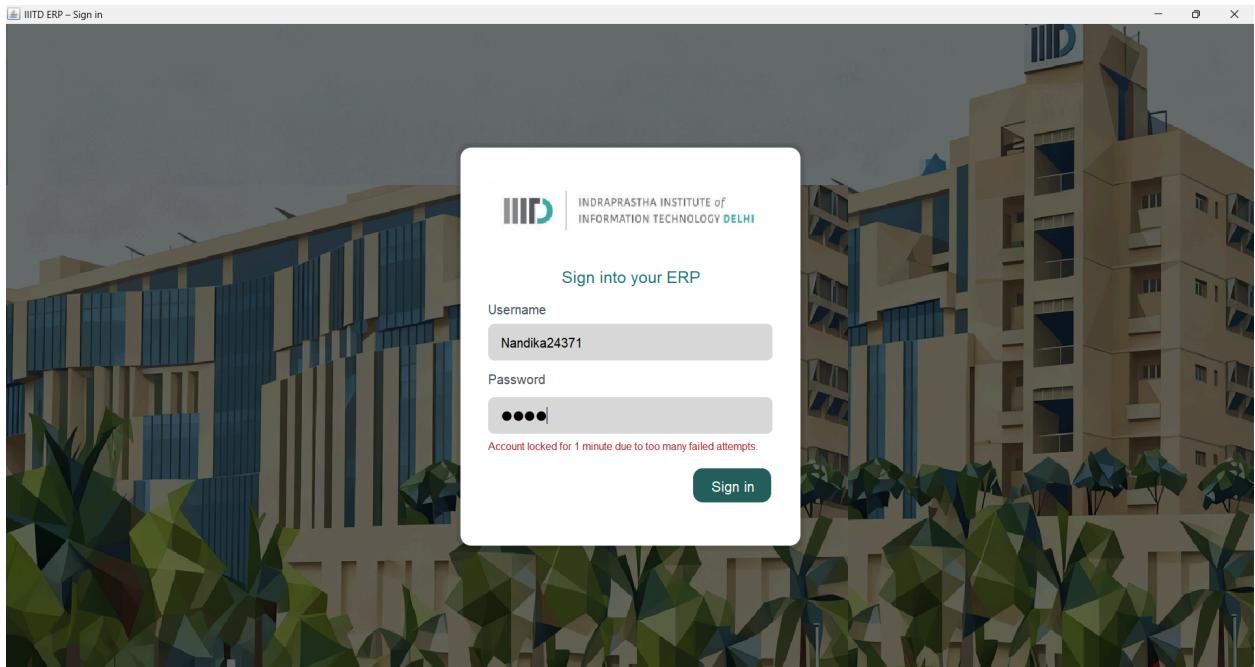
Password Changed Successfully:



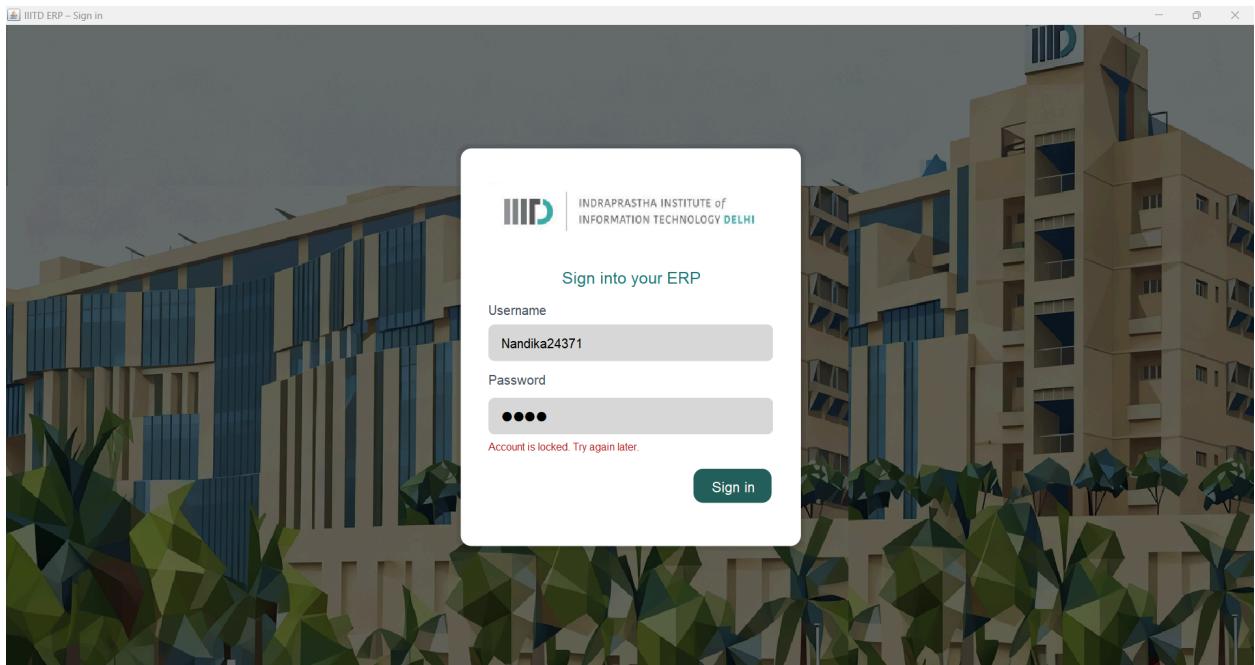
Wrong Password entered at login:



More than 5 failed login attempts:

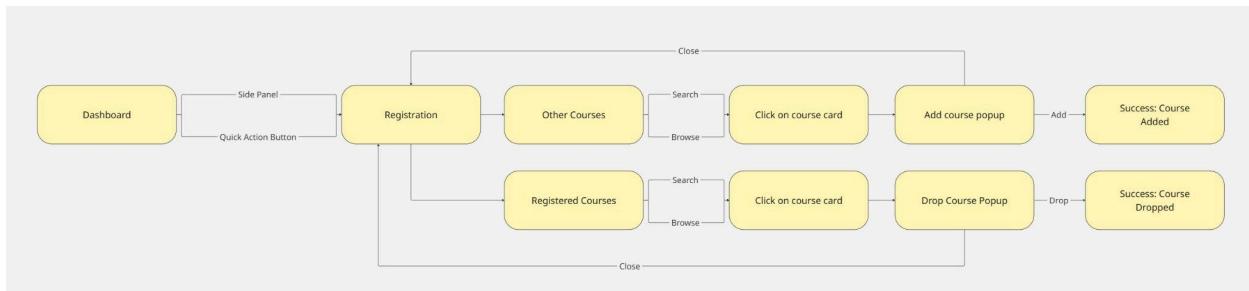


If user tries to login while account is locked:



Student UI Flows:

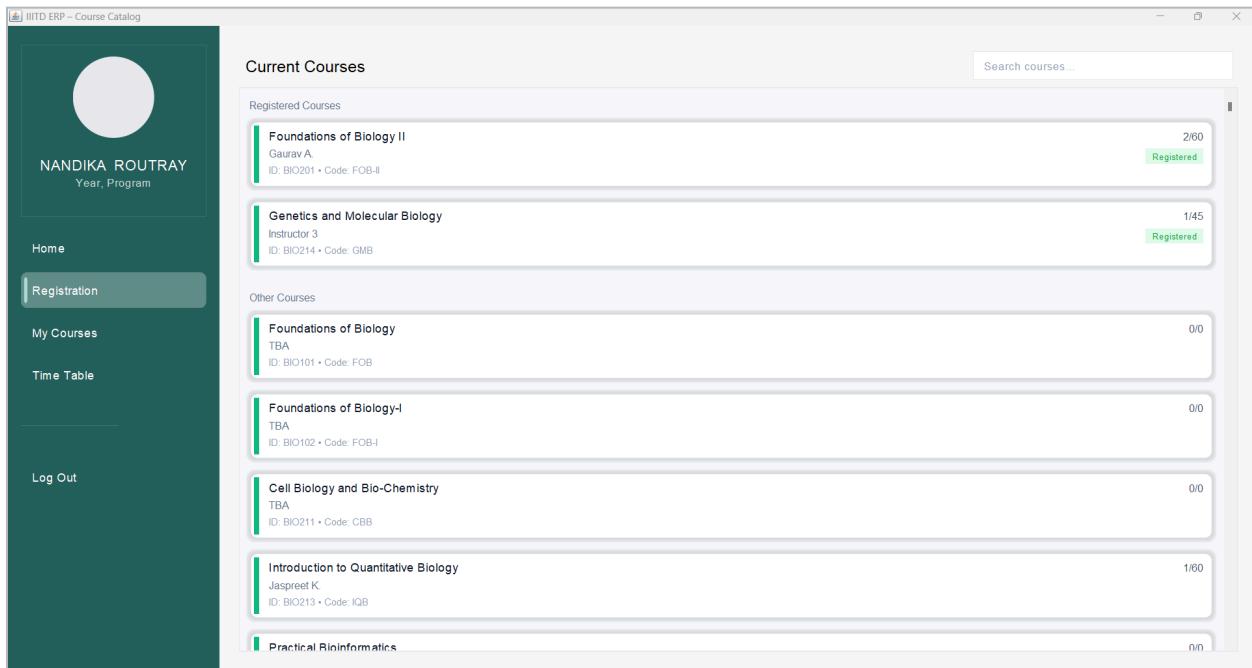
Flow 1 - Register for or Drop a Course



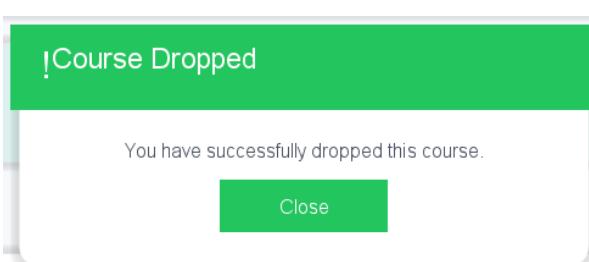
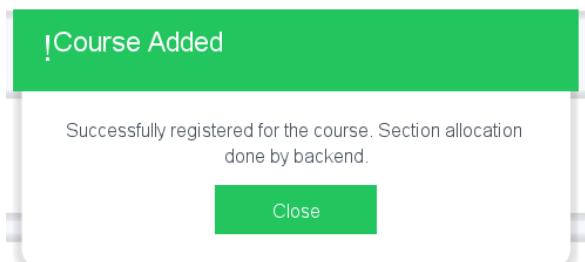
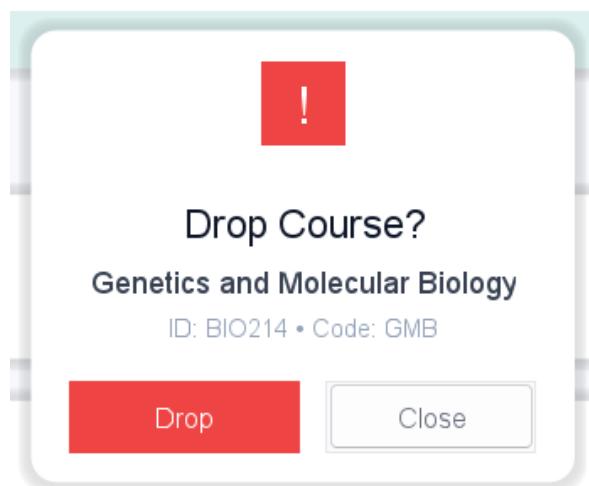
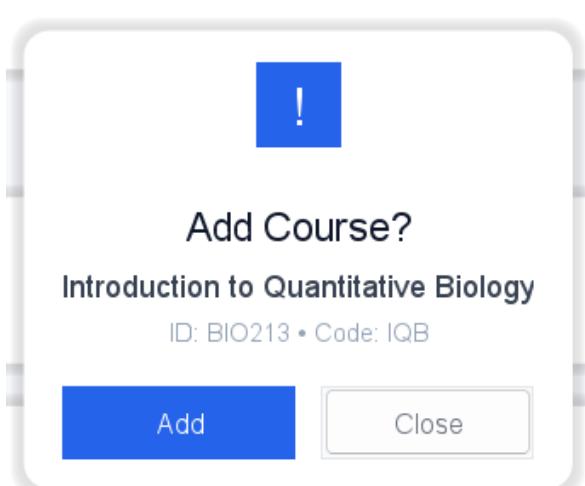
Dashboard:

The screenshot shows the student dashboard for EVANI MENON. The top navigation bar displays the date (28 November 2025), a welcome message ('Welcome, EVANI MENON'), and the student's name ('EVANI MENON Studen'). The left sidebar contains links for Home, Registration, My Courses, Time Table, Log Out, and Settings. The main content area includes a summary of registered courses (0) and total credits (0). Below this, a 'Registered Courses' section shows current term enrollments with a note that no courses are registered yet. To the right is a 'Calendar November 2025' showing the days of the week and dates from 1 to 30, with November 28 highlighted. At the bottom is a 'Today's Timetable' section which indicates no classes are found for today.

Registration:



Click on a Course card from “Other Courses” | Course card from “Registered Courses”



Registration page after adding IQB and Dropping GMB:

The screenshot shows the IIITD ERP Course Catalog interface. On the left, there is a dark sidebar with a user profile placeholder, the name "NANDIKA ROUTRAY", and a "Year, Program" field. Below this are links for "Home", "Registration" (which is highlighted), "My Courses", "Time Table", and "Log Out". The main content area is titled "Current Courses" and contains two sections: "Registered Courses" and "Other Courses".

Registered Courses

- Foundations of Biology II**
Gaurav A.
ID: BIO201 • Code: FOB-II
2/60
Registered
- Introduction to Quantitative Biology**
Jaspreet K.
ID: BIO213 • Code: IQB
2/60
Registered

Other Courses

- Foundations of Biology**
TBA
ID: BIO101 • Code: FOB
0/0
- Foundations of Biology-I**
TBA
ID: BIO102 • Code: FOB-I
0/0
- Cell Biology and Bio-Chemistry**
TBA
ID: BIO211 • Code: CBB
0/0
- Genetics and Molecular Biology**
Instructor 3
ID: BIO214 • Code: GMB
0/45
- Practical Bioinformatics**
TBA
ID: BIO215 • Code: PBB
0/0

A search bar at the top right says "Search courses...".

Flow 2 - View Registered Courses and Grades & Download Transcript

My Courses:

The screenshot shows the 'My Courses' section of the IIITD ERP system. It lists three courses:

- ABC – Course 1**: Course ID ABC101 • 4 credits. Instructor: Instructor 1. Wed 08:00-09:00 • Room B213. Monsoon 2025. Final Grade: B.
- XYZ – Course 2**: Course ID ABC102 • 4 credits. Instructor: Instructor 2. Thu 11:00-12:30 • Room A204. Monsoon 2025. Final Grade: C.
- AP – Advanced Programming**: Course ID CSE201 • 4 credits. Instructor: Samabdhi C. Mon 11:00-12:30 • Room Lab-203. Monsoon 2025. Final Grade: A.

Each course card includes a table of component scores and a progress bar.

Clicking on “Download Transcript”:

The screenshot shows the 'My Courses' section with a 'Download Transcript (PDF)' button clicked. A save dialog box is open, showing the file path 'Save As: transcript_stu1.pdf' and the save button highlighted.

The file list in the dialog shows:

- Name: abc101.csv
- Date Modified: Friday, 28 November, 2025, 12:12 am
- Name: Angry_Birds_AP
- Date Modified: Sunday, 23 November, 2025, 2:50 pm
- Name: Animals
- Date Modified: Monday, 15 July, 2024, 11:47 am
- Name: Applications
- Date Modified: Thursday, 24 July, 2025, 2:15 pm
- Name: assets
- Date Modified: Friday, 27 September, 2024, 5:58 pm
- Name: Blender
- Date Modified: Tuesday, 16 July, 2024, 11:28 pm
- Name: Books
- Date Modified: Monday, 3 November, 2025, 12:28 pm
- Name: BrawhallaReplays
- Date Modified: Saturday, 2 August, 2025, 11:48 pm
- Name: Charts
- Date Modified: Sunday, 28 April, 2024, 8:02 pm
- Name: chatbot.env
- Date Modified: Wednesday, 5 March, 2025, 10:36 nm

Below the dialog, the course cards for ABC, XYZ, and AP are visible with their respective final grades.

A sample downloaded grades transcript will look like this:

Unofficial Transcript
Student: Student 1 (stu1)

ABC – Course 1

Course ID: ABC101 | Credits: 4 | Term: Monsoon 2025

Instructor: Instructor 1

Final Grade: B

Component	Score / Weight
Quizzes	25.0 / 25.0
Midsem	15.0 / 30.0
Endsem	28.0 / 30.0
Assignments	12.0 / 15.0

XYZ – Course 2

Course ID: ABC102 | Credits: 4 | Term: Monsoon 2025

Instructor: Instructor 2

Final Grade: C

Component	Score / Weight
Quizzes	30.0 / 30.0
Midsem	15.0 / 20.0
Endsem	21.0 / 30.0
Labs	5.0 / 20.0

AP – Advanced Programming

Course ID: CSE201 | Credits: 4 | Term: Monsoon 2025

Instructor: Sambuddho C.

Final Grade: A

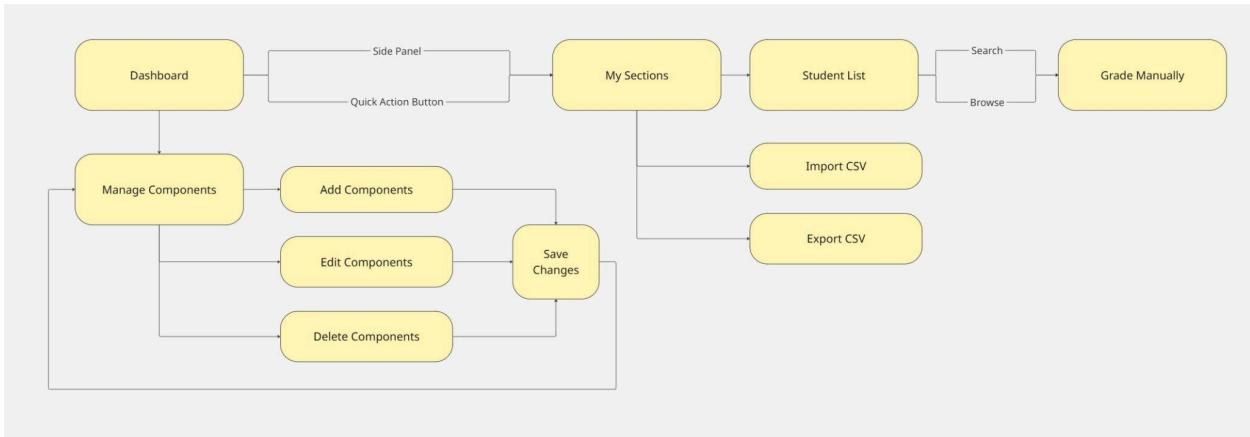
Component	Score / Weight
Midsem	25.0 / 25.0
Endsem	25.0 / 25.0
Assignment 1	10.0 / 10.0
Assignment 2	10.0 / 10.0
Quizzes	10.0 / 10.0
Project	20.0 / 20.0

Flow 3 - View Time Table

The screenshot shows the IIITD ERP - Time Table application interface. On the left, there is a sidebar with a user profile placeholder, the name "EVANI MENON", and "Year, Program". The sidebar also contains links for "Home", "Registration", "My Courses", "Time Table" (which is highlighted in green), "Log Out", and "Settings". The main content area is titled "Class Schedule" and displays a weekly grid from Monday to Sunday. The schedule shows the following details:

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
DS M203							
08:00-09:00							
Home	09:00-10:30						
Registration							
	10:45-12:15						
My Courses							
Time Table	AP Lab-203						
	11:00-12:30						
Log Out							
Settings							
	IQB B201		FOB-II B203				
	13:00-14:00						
	14:00-15:30						
	OS C201						
	16:00-17:30						

Instructor UI Flow:



Dashboard:

The screenshot shows the 'IIITD ERP – Instructor Dashboard' window. The top navigation bar displays the date '27 November 2025' and a welcome message 'Welcome back, gaurav!'. Below the header, there are three summary cards: '0 Sections this semester', '0 Students across sections', and 'Items to grade'. The main content area includes a 'Today's Teaching Schedule' section listing 'CSE101 – Introduction to Programming' from '09:00 – 10:30 • C-101'. Another section lists 'BIO201 – Foundations of Biology II' from '11:00 – 12:30 • B-204' and 'MTH201 – Linear Algebra' from '14:00 – 15:30 • A-102'. On the right, a 'Quick Actions' sidebar offers links to 'My Sections', 'This Week' (with a note about an upcoming quiz), and 'Publish feedback for Assignment 1'. The left sidebar features a user profile for 'gaurav' (Department: BIO) and a navigation menu with 'Home' (selected), 'My Sections', 'Manage Components', 'Settings', and 'Log Out'.

My Sections

The screenshot shows the 'My Sections' page of the IIITD ERP system. On the left is a sidebar with a user profile for 'inst1' (Department: CSD) and links for Home, My Sections (which is selected), Manage Components, Settings, and Log Out. The main content area displays a single section card for 'ABC101'. The card includes the section code, schedule ('Section 3 • Wed 08:00-09:00'), room ('Room B213 • Monsoon 2025'), and capacity ('Capacity: 2'). The top right of the card shows the message 'Logged in as inst1'.

Clicking on Section Card:

The screenshot shows the detailed statistics for 'ABC101 — Section 3'. The sidebar remains the same as the previous screenshot. The main content area now displays various metrics and charts. At the top, it shows '2 Students in section', '78.5 % Mean final percentage', and '2 Students with grades'. Below this are two charts: 'Average score per component' (Quizzes: 22, Midsem: 18, Endsem: 27, Assignments: 12) and 'Final grade distribution' (Number of students: ≥ 80%: 1, 70-79%: 1, 60-69%: 0, 50-59%: 0, < 50%: 0). At the bottom is a table of student grades:

Roll No	Full Name	Quizzes (25)	Midsem (30)	Endsem (30)	Assignments (15)	Final Grade
1	Student 1	25.0	15.0	28.0	12.0	80.0
2	Student 2	19.0	21.0	25.0	12.0	77.0

Manage Components:

IITD ERP – Instructor

Course 1 (ABC101)
Semester: Monsoon 2025 | Schedule: Wed 08:00-09:00 | Room: B213 | Capacity: 2

Current Components		
Quizzes	25.0	Remove
Midsem	30.0	Remove
Endsem	30.0	Remove
Assignments	15.0	Remove

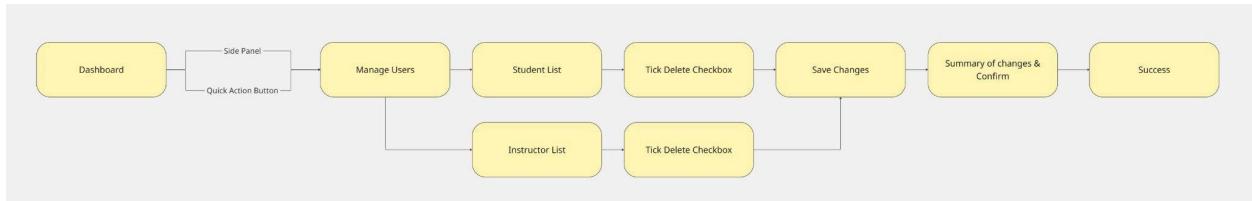
Component Name Weight (%)

+ Add Component

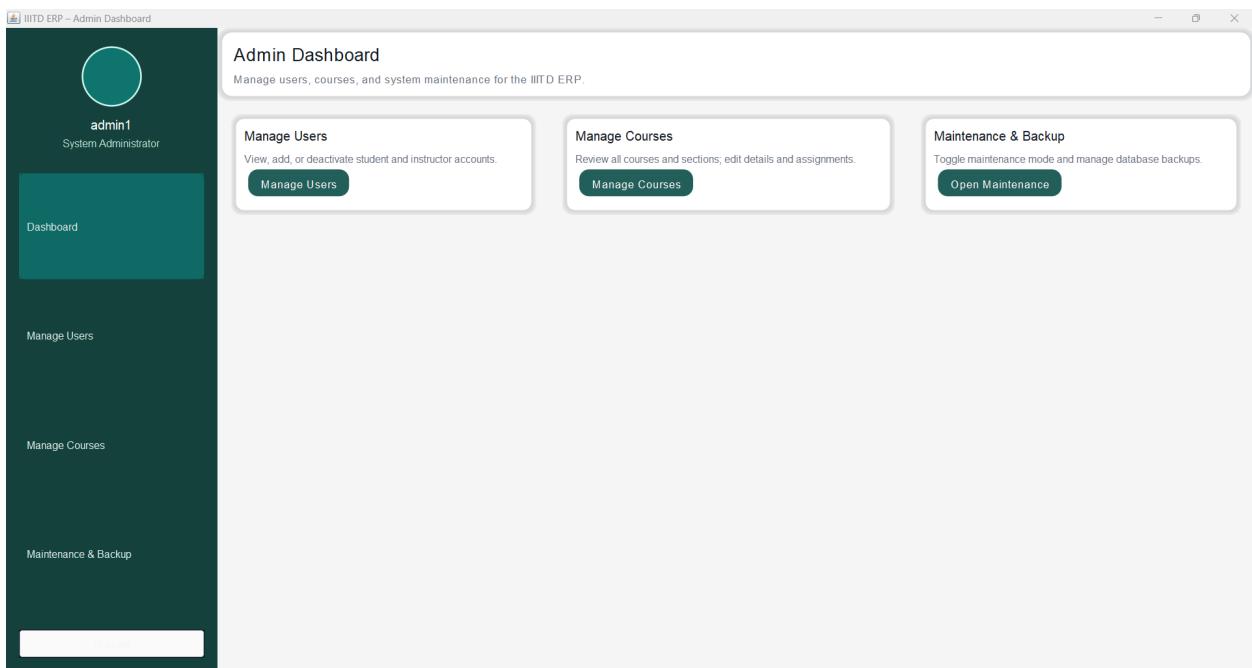
Cancel Save Changes

Admin UI Flows:

Flow 1 - Delete a user



Dashboard:



Manage Users:

The screenshot shows the 'User Management' interface with a sidebar on the left containing 'Dashboard', 'Manage Users' (selected), 'Manage Courses', and 'Maintenance & Backup'. The main area has a title 'User Management' and a subtitle 'Manage all users in one place. Control access and monitor activity.' Below is a search bar and a table titled 'Students'.

User ID	Username	Role	Full Name	Roll No	Program	Year	Status	Last Login	Delete?
3	stu1	student					active	-	<input type="checkbox"/>
4	stu2	student					active	-	<input type="checkbox"/>
2024001	aadi24001	student					active	-	<input type="checkbox"/>
2024003	aaditya24003	student					active	-	<input type="checkbox"/>
2024004	aaditya24004	student					active	-	<input type="checkbox"/>
2024005	aakarshan24005	student					active	-	<input type="checkbox"/>
2024006	aanshi24006	student					active	-	<input type="checkbox"/>
2024007	aanya24007	student					active	-	<input type="checkbox"/>
2024008	aarav24008	student					active	-	<input type="checkbox"/>
2024009	aarush24009	student					active	-	<input type="checkbox"/>
2024010	aaryan24010	student					active	-	<input type="checkbox"/>
2024011	aashish24011	student					active	-	<input type="checkbox"/>
2024012	aastha24012	student					active	-	<input type="checkbox"/>

Below the Students table is another table titled 'Instructors'.

User ID	Username	Role	Full Name	Department	Status	Last Login	Delete?
.....

At the top right are buttons: Add Student, Add Instructor, Save Changes, Export, Import, and Back.

Checked Delete Boxes:

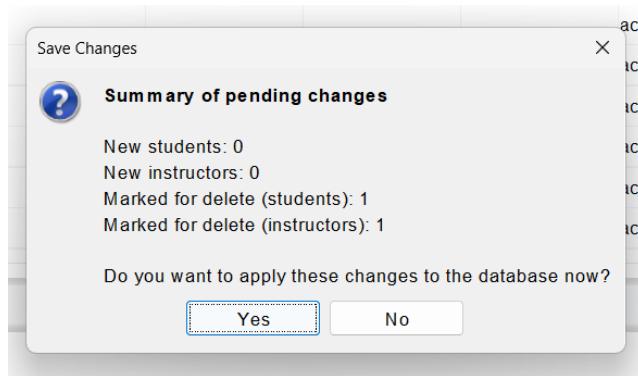
The screenshot shows the 'User Management' interface with the same sidebar and layout as the previous screenshot. The 'Students' table now highlights rows 2024005 and 2024006 with blue background, indicating they have been selected for deletion. The 'Delete?' column for these rows contains a checked checkbox.

User ID	Username	Role	Full Name	Roll No	Program	Year	Status	Last Login	Delete?
2024004	aaditya24004	student					active	-	<input type="checkbox"/>
2024005	aakarshan24005	student					active	-	<input checked="" type="checkbox"/>
2024006	aanshi24006	student					active	-	<input type="checkbox"/>
2024007	aanya24007	student					active	-	<input type="checkbox"/>
2024008	aarav24008	student					active	-	<input type="checkbox"/>
2024009	aarush24009	student					active	-	<input type="checkbox"/>
2024010	aaryan24010	student					active	-	<input type="checkbox"/>
2024011	aashish24011	student					active	-	<input type="checkbox"/>
2024012	aastha24012	student					active	-	<input type="checkbox"/>

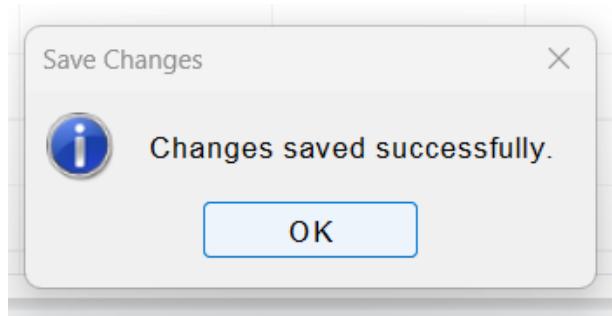
Below the Students table is the 'Instructors' table, which remains empty.

At the top right are buttons: Add Student, Add Instructor, Save Changes, Export, Import, and Back.

Save Changes Popup:



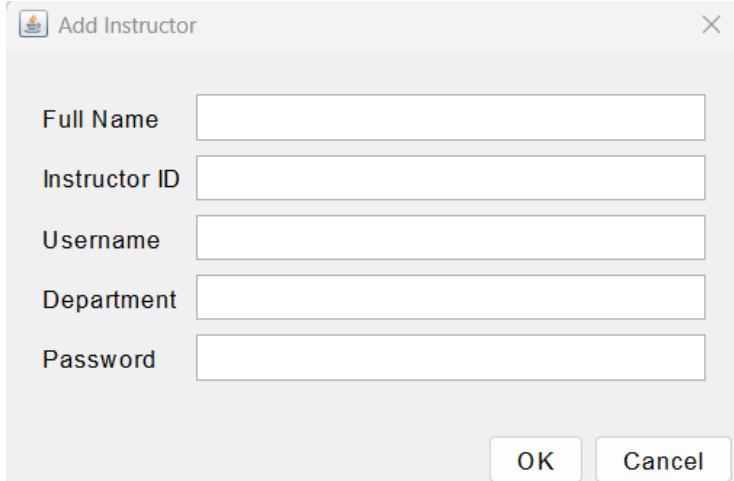
Success:



Add Student:

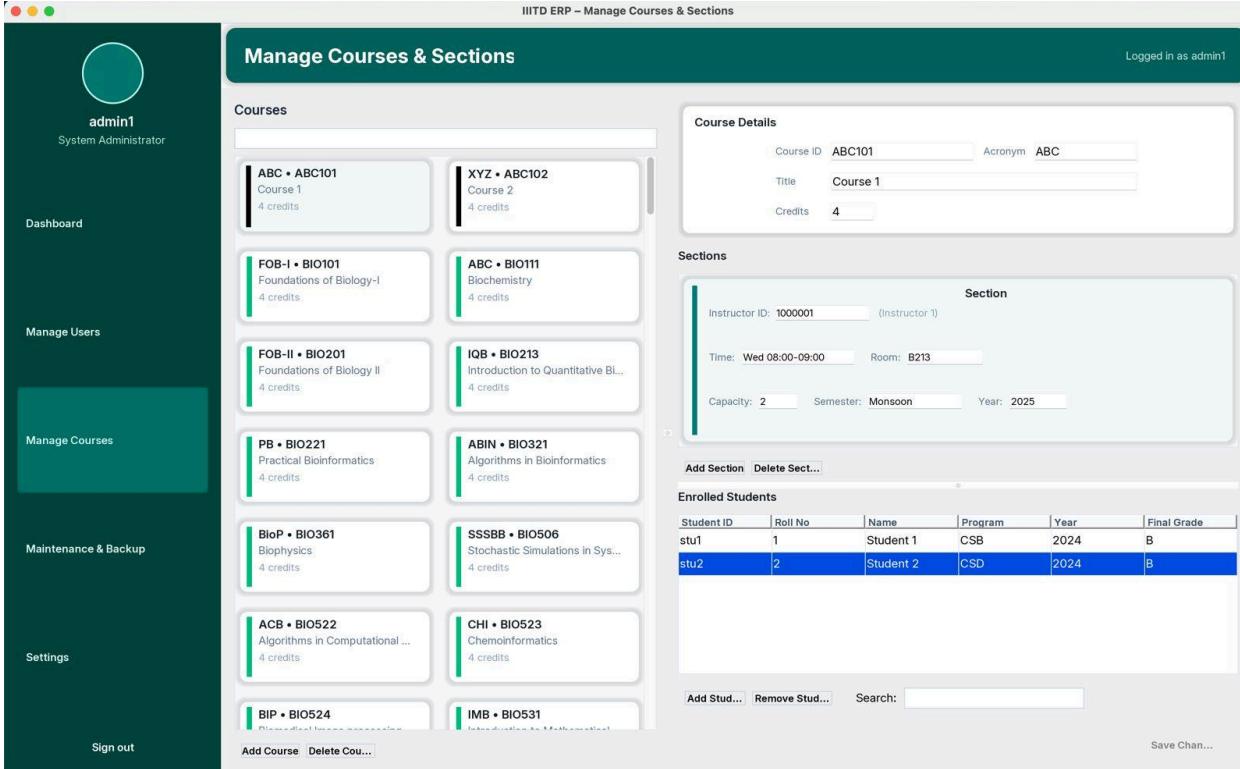
A screenshot of an 'Add Student' dialog box. At the top left is a small student icon. To its right, the text 'Add Student' is displayed. The dialog contains seven text input fields labeled 'Full Name', 'Student ID', 'Username', 'Roll No', 'Program', 'Year', and 'Password'. At the bottom of the dialog are two buttons: 'OK' and 'Cancel'.

Add Instructor:

A screenshot of a "Add Instructor" dialog box. It contains five input fields: "Full Name", "Instructor ID", "Username", "Department", and "Password". Below the fields are two buttons: "OK" and "Cancel".

Flow 2 - Add/Delete/Manage Courses & Sections:

Manage Courses:

A screenshot of the "Manage Courses & Sections" interface. The left sidebar shows navigation options: Dashboard, Manage Users, Manage Courses (selected), Maintenance & Backup, and Settings. The main area has a title "Manage Courses & Sections". On the left, there's a grid of course cards. On the right, there are three sections: "Course Details" (Course ID: ABC101, Acronym: ABC, Title: Course 1, Credits: 4), "Sections" (Instructor ID: 1000001, Time: Wed 08:00-09:00, Room: B213, Capacity: 2, Semester: Monsoon, Year: 2025), and "Enrolled Students" (a table with rows for stu1 and stu2). At the bottom, there are buttons for "Add Sect...", "Delete Sect...", "Add Stud...", "Remove Stud...", "Search:", and "Save Chan...".

Deleting a course:

The screenshot shows the 'Manage Courses & Sections' interface. On the left sidebar, 'Manage Courses' is selected. In the main area, a course card for 'ABC • ABC102' is highlighted. A confirmation dialog box titled 'Confirm Delete Course' appears, asking 'Delete course ABC102?' with options 'Cancel' and 'OK'. The course details panel shows 'Course ID: ABC102', 'Title: Course 2', and 'Credits: 4'. The sections panel lists 'Section' (Instructor: 2), 'Room: A204', 'Semester: Monsoon', and 'Year: 2025'. The enrolled students table is empty.

Searching for a Student:

The screenshot shows the same application interface. A search dialog box titled 'Student Not Found' appears, stating 'No student found for value: 2024691' with an 'OK' button. The course details panel shows 'Course ID: ABC101', 'Title: Course 1', and 'Credits: 4'. The sections panel lists 'Section' (Instructor ID: 1000001), 'Time: 10-09:00', 'Room: B213', 'Semester: Monsoon', and 'Year: 2025'. The enrolled students table shows two entries: 'stu1' and 'stu2'.

Flow 3 - Maintenance Mode:

Maintenance & Backup Page:

The screenshot shows the 'Maintenance & Backup' page. On the left sidebar, under the 'Maintenance & Backup' section, the 'Maintenance Mode' button is highlighted. The main content area displays the 'Maintenance Mode' settings, which are currently off. It includes a toggle switch labeled 'Turn ON maintenance mode...' and a note about its purpose: 'When maintenance is ON, students and instructors can only view data. Use this while performing critical updates or backups.' Below this, there's a 'Backup & Data Export' section with options for exporting core user tables, selected tables, or importing from CSV.

Toggle maintenance mode ON:

The screenshot shows the 'Maintenance & Backup' page after the maintenance mode has been turned on. A modal dialog titled 'Maintenance Mode' is displayed, showing a green status bar with the text 'Maintenance mode is now ON.' and a red circular icon indicating it is active. The 'Turn OFF maintenance mode...' button is now greyed out. The background page remains largely the same, with the 'Maintenance Mode' button still highlighted on the sidebar.

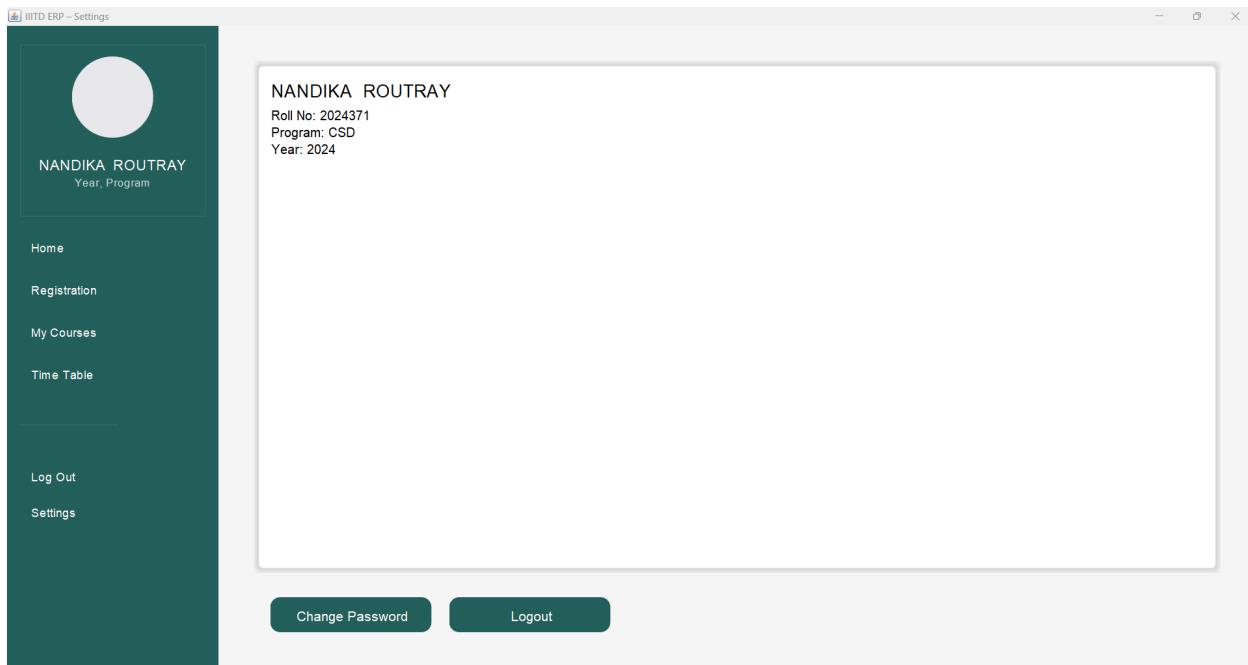
Student tries to register for a course → blocked:

The screenshot shows a student's dashboard with a sidebar on the left containing 'Student 1' profile, 'Home', 'Registration' (which is highlighted), 'My Courses', 'Time Table', 'Log Out', and 'Settings'. The main area is titled 'IITD ERP – Course Catalog' and displays 'Current Courses'. It shows 'Registered Courses' with two entries: 'Course 1' and 'Course 2', both marked as '2/2 Registered'. Below these are 'Other Courses' with four entries: 'Advanced Programming', 'Foundations of Biology-I', 'Biochemistry', and 'Foundations of Biology II'. A prominent red modal window in the center says 'Maintenance mode' and states 'You cannot add or drop courses while the system is in maintenance mode.' with a 'Close' button.

Admin Toggles maintenance mode OFF:

The screenshot shows an administrator's dashboard with a sidebar on the left containing 'admin1' profile, 'System Administrator', 'Dashboard', 'Manage Users', 'Manage Courses', 'Maintenance & Backup' (which is highlighted), and 'Settings'. The main area is titled 'IITD ERP – Maintenance & Backup' and shows 'Maintenance Mode' status as 'OFF'. It has a 'Confirm Maintenance Mode' button. Below it is a 'Backup & Data' section with options like 'Download CSV snapshot', 'Export core user...', 'Export selected table...', and 'Import from CSV (coming soon)'. A confirmation dialog box is overlaid on the page, asking 'Turn OFF maintenance mode and re-enable editing?' with 'No' and 'Yes' buttons, where 'Yes' is highlighted in blue.

General Flow - Settings:



Change Password:

