1. Authentication and Access Control

Problem: Ensuring only authorized users (students or librarians) can access the system is critical for security. Incorrect credentials or unauthorized access attempts pose a major challenge.

Solution: The system employs a function `Authenticate(userID, password)` that verifies credentials before allowing access to user pages. If the authentication fails, the system provides an appropriate error message ("Wrong Credentials") and denies further access. This prevents unauthorized users from manipulating library records.

2. Book Availability Management

Problem: A major issue in library systems is tracking the availability of books. If multiple users attempt to borrow the same book simultaneously, inconsistencies may occur.

Solution: The `CheckBookStatus(ISBN)` function ensures that book status (Available or Not Available) is verified before any borrowing operation. If the book is already taken, the system displays a message to the user, preventing duplication. The `MakeBookUnavailable` and `MakeBookAvailable` functions update the database to reflect real-time changes.

3. User Role Management

Problem: Different user roles (students vs. librarians) require distinct permissions and functionalities. Mixing roles could result in unauthorized actions.

Solution: The system differentiates actions based on user type. Students are limited to borrowing and submitting books, whereas librarians can borrow, receive, and edit the database. This separation ensures proper access control and prevents misuse.

4. Database Integrity

Problem: Manual or programmatic changes to the database can introduce inconsistencies or errors, compromising the integrity of library records.

Solution: The `EditDatabase` function allows librarians to make changes while ensuring updates are validated and stored correctly. Functions like `UpdateBookStatus` and `ChangesToDatabase` ensure systematic updates to the database, reducing the risk of corruption.

5. Handling Errors and Feedback

Problem: Users need clear feedback when operations fail (e.g., borrowing a taken book or inputting incorrect credentials).

Solution: The system includes messages such as "Wrong Credentials" and "Book Already Taken" to inform users about issues. This improves user experience by providing immediate and actionable feedback.

Conclusion

The system described in the flowchart and pseudocode addresses common challenges in library management by incorporating robust authentication, role-based access control, real-time book status tracking, and database integrity mechanisms. While effective, the system could further benefit from additional features like handling multiple concurrent users, logging failed login attempts, or implementing automated notifications for book returns. Overall, the design provides a solid foundation for a functional and efficient library management application.