

# Traceability Matrix

Req ID	Requirement	Design Artifacts
<b>Timetable Management Module</b>		
FR1	Create Timetable	<ul style="list-style-type: none"> <li>- Use Case: Create Timetable</li> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Sequence Diagram: Timetable Creation with Conflict Detection</li> <li>- Activity Diagram: Timetable Creation and Publishing Workflow</li> <li>- Classes: Timetable, TimetableManagementService, TimetableEntry, Course, User, Venue, TimeSlot, Department</li> <li>- Components: Timetable Management</li> </ul>
FR2	Edit Timetable	<ul style="list-style-type: none"> <li>- Use Case: Edit Timetable</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Activity Diagram: Timetable Creation and Publishing Workflow</li> <li>- Classes: Timetable, TimetableManagementService, TimetableEntry, TimetableVersion</li> <li>- Components: Timetable Management</li> </ul>
FR3	Delete Timetable	<ul style="list-style-type: none"> <li>- Use Case: Delete Timetable</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Classes: Timetable, TimetableManagementService</li> <li>- Components: Timetable Management</li> </ul>
FR4	Conflict Detection	<ul style="list-style-type: none"> <li>- Use Case: Detect Conflicts</li> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: Conflict Management Module</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Sequence Diagram: Timetable Creation with Conflict Detection</li> <li>- Activity Diagram: Conflict Detection and Resolution Workflow</li> <li>- Classes: Conflict, ConflictDetectionEngine, TimetableEntry, ConflictManagementService</li> <li>- Components: Conflict Detector</li> </ul>

Req ID	Requirement	Design Artifacts
FR5	Conflict Resolution Suggestions	<ul style="list-style-type: none"> <li>- Use Case: Resolve Conflicts</li> <li>- DFD Level 2: Conflict Management Module</li> <li>- Sequence Diagram: Conflict Resolution with Suggestions</li> <li>- Activity Diagram: Conflict Detection and Resolution Workflow</li> <li>- Classes: ConflictResolution, ConflictResolver, ConflictManagementService</li> <li>- Components: Resolution, Conflict Detector</li> </ul>
FR6	Publish Timetable	<ul style="list-style-type: none"> <li>- Use Case: Publish Timetable</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Sequence Diagram: Timetable Publishing</li> <li>- Activity Diagram: Timetable Creation and Publishing Workflow</li> <li>- Classes: Timetable, TimetableManagementService, NotificationService</li> <li>- Components: Timetable Management</li> </ul>
FR7	Archive Timetable	<ul style="list-style-type: none"> <li>- Use Case: Archive Timetable</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Classes: Timetable, TimetableManagementService</li> <li>- Components: Timetable Management</li> </ul>
FR8	Import and Export Timetable	<ul style="list-style-type: none"> <li>- Use Case: Import/Export Timetable</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Classes: FileParser, ExportService, Report</li> <li>- Components: Timetable Management</li> </ul>
FR9	Bulk Operations	<ul style="list-style-type: none"> <li>- Use Case: Edit Timetable</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Activity Diagram: Timetable Creation and Publishing Workflow</li> <li>- Classes: TimetableEntry, TimetableManagementService</li> <li>- Components: Timetable Management</li> </ul>
FR10	Timetable Versioning	<ul style="list-style-type: none"> <li>- DFD Level 2: Timetable Management Module</li> <li>- Classes: TimetableVersion, TimetableManagementService</li> <li>- Components: Timetable Management</li> </ul>
<b>Conflict Management Module</b>		

Req ID	Requirement	Design Artifacts
FR11	Conflict Report	<ul style="list-style-type: none"> <li>- Use Case: View Conflict Report</li> <li>- DFD Level 2: Conflict Management Module</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Activity Diagram: Report Generation Workflow</li> <li>- Classes: ConflictReport, ReportingService, ConflictManagementService</li> <li>- Components: Reporting</li> </ul>
FR12	Track Resolution Status	<ul style="list-style-type: none"> <li>- Use Case: View Conflict Report</li> <li>- DFD Level 2: Conflict Management Module</li> <li>- Activity Diagram: Conflict Detection and Resolution Workflow</li> <li>- Classes: Conflict, ConflictManagementService</li> <li>- Components: Conflict Detector</li> </ul>
FR13	Automated Conflict Resolution	<ul style="list-style-type: none"> <li>- Use Case: Resolve Conflicts</li> <li>- DFD Level 2: Conflict Management Module</li> <li>- Sequence Diagram: Conflict Resolution with Suggestions</li> <li>- Activity Diagram: Conflict Detection and Resolution Workflow</li> <li>- Classes: ConflictResolution, ConflictResolver, ConflictManagementService</li> <li>- Components: Resolution, Conflict Detector</li> </ul>
<b>User Management Module</b>		
FR14	User Registration	<ul style="list-style-type: none"> <li>- Use Case: Manage Users</li> <li>- Context Diagram (Level 0)</li> <li>- Activity Diagram: User Registration Workflow</li> <li>- Classes: User, UserManagementService, AuthenticationService</li> <li>- Components: User Manager</li> </ul>
FR15	User Login and Authentication	<ul style="list-style-type: none"> <li>- Use Case: Login</li> <li>- Context Diagram (Level 0)</li> <li>- Sequence Diagram: User Login</li> <li>- Activity Diagram: User Login Workflow</li> <li>- Classes: User, AuthenticationService, Session</li> <li>- Components: Auth Service</li> </ul>
FR16	Role-Based Access Control	<ul style="list-style-type: none"> <li>- Use Case: Login</li> <li>- Context Diagram (Level 0)</li> <li>- Classes: User, AuthenticationService, SecurityService</li> <li>- Components: RBAC, Access Control</li> </ul>
FR17	User Profile Management	<ul style="list-style-type: none"> <li>- Use Case: Update Profile</li> <li>- Classes: User, UserManagementService</li> <li>- Components: User Manager</li> </ul>

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FR18	Password Reset	<ul style="list-style-type: none"> <li>- Use Case: Login</li> <li>- Sequence Diagram: Password Reset</li> <li>- Activity Diagram: Password Reset Workflow</li> <li>- Classes: AuthenticationService, EmailService</li> <li>- Components: Auth Service, Email Server</li> </ul>
FR19	Bulk User Import	<ul style="list-style-type: none"> <li>- Use Case: Manage Users</li> <li>- Sequence Diagram: Bulk User Import</li> <li>- Activity Diagram: Bulk User Import Workflow</li> <li>- Classes: UserManagementService, FileParser, User, EmailService</li> <li>- Components: User Manager</li> </ul>
FR20	User Deactivation	<ul style="list-style-type: none"> <li>- Use Case: Manage Users</li> <li>- Classes: User, UserManagementService</li> <li>- Components: User Manager</li> </ul>
FR21	Multi-Factor Authentication	<ul style="list-style-type: none"> <li>- Use Case: Login</li> <li>- Sequence Diagram: User Login</li> <li>- Activity Diagram: User Login Workflow</li> <li>- Classes: AuthenticationService, Session</li> <li>- Components: Auth Service</li> </ul>
<b>Notification and Communication Module</b>		
FR22	Email Notifications	<ul style="list-style-type: none"> <li>- Use Case: Send Notifications</li> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: Notification and Communication Process</li> <li>- Sequence Diagram: Notification and Communication</li> <li>- Activity Diagram: Notification Delivery Workflow</li> <li>- Classes: Notification, EmailService, NotificationService</li> <li>- Components: Notification Service, Email Server</li> </ul>
FR23	In-App Notifications	<ul style="list-style-type: none"> <li>- Use Case: View Notifications</li> <li>- DFD Level 2: Notification and Communication Process</li> <li>- Sequence Diagram: Notification and Communication</li> <li>- Activity Diagram: Notification Delivery Workflow</li> <li>- Classes: Notification, NotificationService</li> <li>- Components: Notification Service</li> </ul>

Req ID	Requirement	Design Artifacts
FR24	Scheduled Notifications	<ul style="list-style-type: none"> <li>- Use Case: Send Notifications</li> <li>- DFD Level 2: Notification and Communication Process</li> <li>- Activity Diagram: Notification Delivery Workflow</li> <li>- Classes: Notification, NotificationService</li> <li>- Components: Notification Service</li> </ul>
FR25	Notification Preferences	<ul style="list-style-type: none"> <li>- Use Case: Update Profile</li> <li>- DFD Level 2: Notification and Communication Process</li> <li>- Classes: NotificationPreference, NotificationService</li> <li>- Components: Notification Service</li> </ul>
<b>Reporting Module</b>		
FR27	Timetable Summary Report	<ul style="list-style-type: none"> <li>- Use Case: Generate Reports</li> <li>- Context Diagram (Level 0)</li> <li>- Activity Diagram: Report Generation Workflow</li> <li>- Classes: TimetableSummaryReport, ReportingService, ReportGenerator, Report</li> <li>- Components: Reporting</li> </ul>
FR28	Resource Utilization Report	<ul style="list-style-type: none"> <li>- Use Case: Generate Reports</li> <li>- Activity Diagram: Report Generation Workflow</li> <li>- Classes: ResourceUtilizationReport, ReportingService, ReportGenerator, Report</li> <li>- Components: Reporting</li> </ul>
FR29	Audit Log Report	<ul style="list-style-type: none"> <li>- Use Case: Generate Reports</li> <li>- Context Diagram (Level 0)</li> <li>- Activity Diagram: Report Generation Workflow</li> <li>- Classes: AuditLogReport, AuditLog, AuditLogService, ReportingService</li> <li>- Components: Audit Service</li> </ul>
<b>Resource Management Module</b>		
FR30	Venue and Classroom Management	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- Context Diagram (Level 0)</li> <li>- Classes: Venue, ResourceManagementService, Booking</li> <li>- Components: Resource Management</li> </ul>
FR31	Lab Management	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- Classes: Venue, ResourceManagementService, Booking</li> <li>- Components: Resource Management</li> </ul>
FR32	Resource Constraints	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- Classes: ConflictDetectionEngine, CourseConstraint, TimetableEntry</li> <li>- Components: Resource Management</li> </ul>

Req ID	Requirement	Design Artifacts
FR33	Resource Conflict Detection	<ul style="list-style-type: none"> <li>- Use Case: Detect Conflicts</li> <li>- DFD Level 2: Conflict Management Module</li> <li>- Activity Diagram: Conflict Detection and Resolution Workflow</li> <li>- Classes: ConflictDetectionEngine, ResourceManagementService, Booking</li> <li>- Components: Conflict Detector, Resource Management</li> </ul>
<b>Course and Department Management</b>		
FR34	Course Registry	<ul style="list-style-type: none"> <li>- Use Case: Manage Courses</li> <li>- Context Diagram (Level 0)</li> <li>- Classes: Course, CourseManagementService, Department</li> <li>- Components: Course Management</li> </ul>
FR35	Department Management	<ul style="list-style-type: none"> <li>- Use Case: Manage Departments</li> <li>- Context Diagram (Level 0)</li> <li>- Classes: Department, CourseManagementService</li> <li>- Components: Course Management</li> </ul>
FR36	Course Constraints	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- Classes: CourseConstraint, Course</li> <li>- Components: Course Management</li> </ul>
<b>Dashboard Module</b>		
FR37	Admin Dashboard	<ul style="list-style-type: none"> <li>- Use Case: Generate Reports, Manage Users, Manage Departments, Manage Courses, Configure System</li> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: Dashboard</li> <li>- Classes: Dashboard, AdminDashboard, DashboardService</li> <li>- Components: Search, Search Engine</li> </ul>
FR38	Faculty Dashboard	<ul style="list-style-type: none"> <li>- Use Case: View Timetable, View Notifications, Update Profile</li> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: Dashboard</li> <li>- Classes: Dashboard, FacultyDashboard, DashboardService</li> <li>- Components: Search, Search Engine</li> </ul>
FR39	Student Dashboard	<ul style="list-style-type: none"> <li>- Use Case: View Timetable, View Notifications, Update Profile</li> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: Dashboard</li> <li>- Classes: Dashboard, StudentDashboard, DashboardService, ExportService</li> <li>- Components: Search, Search Engine</li> </ul>

Req ID	Requirement	Design Artifacts
FR40	Filter and Sort	<ul style="list-style-type: none"> <li>- Use Case: View Timetable</li> <li>- DFD Level 2: Dashboard</li> <li>- Classes: DashboardService</li> <li>- Components: Search, Search Engine</li> </ul>
<b>System Configuration Module</b>		
FR41	Academic Calendar Setup	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: System Configuration</li> <li>- Classes: TimeSlot</li> <li>- Components: Config Manager</li> </ul>
FR42	Time Slot Configuration	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- DFD Level 2: System Configuration</li> <li>- Classes: TimeSlot</li> <li>- Components: Config Manager</li> </ul>
FR43	System Settings	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- DFD Level 2: System Configuration</li> <li>- Classes: NotificationService, EmailService</li> <li>- Components: Config Manager</li> </ul>
FR44	Constraint Configuration	<ul style="list-style-type: none"> <li>- Use Case: Configure System</li> <li>- DFD Level 2: System Configuration</li> <li>- Classes: CourseConstraint, ConflictDetectionEngine</li> <li>- Components: Config Manager</li> </ul>
<b>Data Integrity and Security</b>		
FR45	Data Validation	<ul style="list-style-type: none"> <li>- Context Diagram (Level 0)</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- DFD Level 2: Conflict Management Module</li> <li>- DFD Level 2: System Configuration</li> <li>- Classes: TimetableManagementService, UserManagementService, FileParser, SecurityService, TimetableEntry</li> <li>- Components: Validation</li> </ul>
FR46	Data Consistency	<ul style="list-style-type: none"> <li>- Context Diagram (Level 0)</li> <li>- Classes: Course, Timetable</li> <li>- Components: PostgreSQL/MySQL</li> </ul>
FR47	Access Control	<ul style="list-style-type: none"> <li>- Use Case: All system operations</li> <li>- Context Diagram (Level 0)</li> <li>- Sequence Diagram: User Login</li> <li>- Classes: User, AuthenticationService, SecurityService</li> <li>- Components: Access Control, RBAC</li> </ul>

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FR48	Data Backup	<ul style="list-style-type: none"> <li>- Use Case: Backup Data</li> <li>- Context Diagram (Level 0)</li> <li>- Classes: SecurityService</li> <li>- Components: Data Security, Timetable Management</li> </ul>
<b>Timetable Generation Module</b>		
FR49	Automatic Timetable Generation	<ul style="list-style-type: none"> <li>- Use Case: Generate Timetable (Create Timetable)</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Sequence Diagram: Automatic Timetable Generation</li> <li>- Activity Diagram: Auto Timetable Generation Workflow</li> <li>- Classes: Timetable, TimetableEntry, TimetableManagementService, Course, User, Venue, TimeSlot, CourseConstraint, ConflictDetectionEngine</li> <li>- Components: Generator</li> </ul>
FR50	Draft Review and Approval	<ul style="list-style-type: none"> <li>- Use Case: Validate Timetable</li> <li>- DFD Level 2: Timetable Management Module</li> <li>- Sequence Diagram: Timetable Publishing</li> <li>- Activity Diagram: Timetable Creation and Publishing Workflow</li> <li>- Classes: Timetable, TimetableVersion, TimetableManagementService, ConflictDetectionEngine</li> <li>- Components: Timetable Management</li> </ul>