1. INTRODUCTION

Time Table Management system is an automated system which generates time table according to the data given by the user. The main requirement of the application is to provide the details about the branch, subjects, number of labs, total number of period and details about the lab assistance. Then the application generates the time table as per the requirement.

1.1 Terminologies and Definition

Development of College Timetable Management System to generate and manage timetable for an institution, the following terminologies were used.

- Faculty Id: Each faculty has a unique id, which cannot be altered. It is used by a teacher to login to the system and use it.
- Subject Id: Each subject has a unique id given by the university.
- Lab Id: Each lab has a unique id which cannot be altered.
- Admin Rights: Admin can only generate the timetable no other faculty can generate timetable. Admin rights are not given to all faculties it may or may not be given to all head of the department.

1.2 Problem Definition

College Timetable Management System is an automated system developed for any institution. Timetabling is the allocation, subject to constraints, of given resources to objects in space-time domain to satisfy a set of desirable objectives as nearly as possible. Particularly, the university timetabling problem for courses can be viewed as fixing in time and space a sequence of meetings between instructors and students, while simultaneously satisfying a number of various essential conditions or constraints. Planning timetables is one of the most complex and error-prone applications. There are still serious problems occurring and these problems are repeating frequently. Therefore there is a great requirement for an application distributing the courses evenly and without collisions. Graph coloring algorithm is one of the most used algorithms. [1]

Manually creating a timetable and managing it is a very tedious job and maintain all the databases required to design the timetable is very time consuming. So we intend to design an automated system which will generate the timetable considering faculty details, semester details etc.

1.3 Objectives

To create a College Timetable Management System to be used by any Institution and will reduce time consumption and the labor of manually designing the timetable and managing it.

1.4 Tools & Platform

The following tools and platform were used in developing the software for generating the timetable and should be present at developer's side along with the software mentioned for client's side.

1.4.1 Software Requirements

Language used for implementation

- J2EE(Java Enterprise Edition)
- HTML5

- CSS
- JavaScript

- ➢ For Developer’s side:

    - OS: Windows 7 or above
    - Code: J2EE(Java Enterprise Edition)
    - Platform : Eclipse IDE
    - Database: MySQL 5.5 or higher
    - Server: Wildfly
    - Internet Browser: Any standard Internet Browser

- ➢ For Client’s side:

    - OS: Any operating system
    - Browser: Any standard Internet browser

1.4.2 Hardware Requirements

- ➢ For Developer’s side:

    - RAM: 2 GB or higher
    - Hard disk: 80 GB or more free space
    - Processor: 1.8 GHz or higher
    - Intranet Connection

- ➢ For Client’s side:

    - RAM: 512MB or higher
    - Processor: 1.8 GHz or higher

1.5. Project Organization

The project started in August 2016 and ended in April 2017, the duration was 9 months and the following were phases for building the project.

- Requirement Analysis
- Technology familiarization
- Algorithm Design
- High level detailed design
- Coding and Implementation
- Testing.

Figure 1 shows the progress chart of the project it shows all the phases and hours dedicated for it.

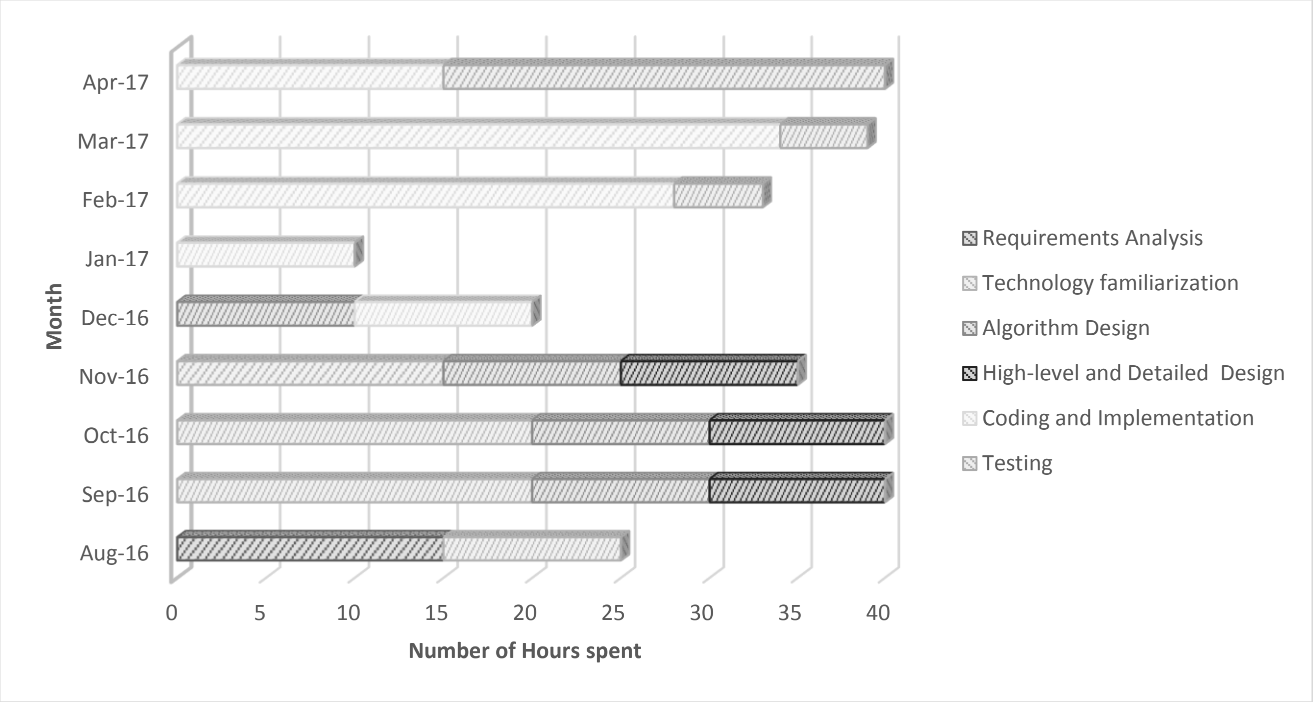

Figure 1: Progress Chart

2. Literature Review

There are few research working papers on university timetable that are published. Most of the timetable system produced can only be used at the university involved in the research, as each university has its own needs and requirements that differs specifically.

2.1. Graph Coloring:

Most timetable software is based on graph delegation. Graph can be defined as vertex connected by lines where dots will represent events and line will correlate with those events. A vertex in Graph represents a subject, an edge represents a pair of courses that conflict, and a color represents the period in which that particular course is to be scheduled. The objective is to find minimum color and make a suitable timetable using it. The minimum coloring problem and the timetabling problem have been classified as NP-hard problems in the general case. This means that it is unlikely that it will be possible to find fast (i.e., polynomial-time) algorithms to solve these problems. In order to find optimal solutions to such NP-hard problems, it is usually necessary to consider all possible solutions to choose the best one.[2]

Strength: No conflict occurred because different colors were used for every subject
Weakness: Could not represent certain elements such as connecting two different subjects with different time.

2.2. Network flow technique:

Dyer and Mulvey (1976), Mulvey (1982), Chahal and de Werra (1989), Dinkel et al (1989) propose to use a network model as the core of the timetabling algorithm. The network employed by Dinkel et al. contains three levels, plus a source and a sink vertex. The first level is the Department Level which includes a vertex for each department, such that all of these vertices are connected to the source. The second level is the Faculty/Staff Level which includes a vertex for each possible combination of teacher and course taught by the teacher; these vertices are connected to the vertices representing the departments to which the teachers belong. The third level is the Room Size/Time Level, which contains a vertex for each combination of room and time. Each vertex of this level is connected to a vertex of the second level only if the size of the room represented by the vertex in compatible with the number of students of the course represented by the other vertex. An edge between levels 2 and 3 represents a possible lecture. The capacities and the lower bounds of edges representing the lectures are 0 and 1 respectively and due to uni-modularity this ensures that the optimal solution to the problem will possess all integer values. The coefficients of the objective function are assigned based on availabilities of teachers and rooms and preferences of the teachers. [3]

Strength: Allocate time for the combination of lecturer-classroom whereby no conflicts generated in the schedule.
Weakness: The network model does not prevent the solution from assigning a single teacher to multiple lectures at the same time.

2.3 Integer Programming Approach:

Linear programming is a mathematical technique to aid in obtaining the most effective decision by utilizing all available resources. In general definition, it is also known as mathematical programming. Integer programming yield solutions for linear programming hitches. Integer programming faces the same setback as linear programming by reason of nearly every variable must be optimize with positive integer.

Difficulties faced when using this approach is the event of too many or all variables in the formula is integer in value and normally the size of the problem is big. It involves extensive calculation time and probability to solve the situation without utilizing mathematical approach. Carter (1995) commented that each problem must be solved mathematically, the number of variables and constraints will be too complicated to manage when facing large problem

Strength: Aid in obtaining the most effective decision by utilizing all available resources
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3. Concept and problem analysis

Timetable is the first and foremost tool in the academic and administrative management of the educational systems. Since generation of a time table is a tedious process and there are various permutations and combinations required to get the correct class-wise flow, the timetable software aims to automate this process. The timetable software tracks all subjects and classes and offers various combinations to the user to choose from. The timetable software is a user-friendly automated process that gives flexibility and a combination of options.

Our basic function is to create a time table for a college including different departments and semester. The main problem that occurred during the project is to create and maintain the databases of different entities involved in this process. The database contains the information about the various semesters, subjects, lab, teachers etc. So maintain such a large database is a big challenge for us. The problem we face during our project is how the collision of two subjects or the teachers can avoid. Every project has some drawbacks. Off period were coming in between two period. So, these are some problem which we face in our project.

In a typical semester, the courses are required to be scheduled at different times in order to avoid conflict. The formal definition for university timetable is given in detailed by Carter et al (1995).In event that the following resources and time slot exist as follows:

- A set of lecturers {t1, t2,............,tn}
- A set of subjects {c1, c2,.......,cm}
- A set of classes {r1, r2,...............,rq}
- A set of time {p1, p2.................ps}

As a preliminary step, construct a three verse set to represent the requirement which are (i=1, 2....n), (j=1, 2..........m) and (k=1, 2....q). Each set indicates lecturer ti lecturing the subject cj in class rk. Further, determine each three verse set to time p1 which is (i =1, 2.....s). This will form a four verse set < ti, cj, rk, p1> which represents the stipulation that lecturer t, lectures the subject c, class r and at p time. For every two four verse set, for example < te, cf, rg, ph>< tw, cx, ry, pz> and the constriction below must be fulfilled. :

If te = tw hence ph ≠ pz (1)
If cf = cx hence ph ≠ pz (2)
If rg = ry hence ph ≠ pz (3)

Constriction (1) ensures that no lecturer will scheduled for more than once in each period, constriction (2) ensures that no subject will be scheduled for the same time and constriction (3) ensures that no class is scheduled for more than once for each period. [2]

The problem is to design an algorithm to create a semester course timetable by assigning time slots and rooms to given set of courses to be run that semester under given constraints. The constraints include avoiding clashes of time slots and rooms, assigning appropriate rooms and appropriate number of slots and contact hours to the courses etc. although most of the college administrative work has been computerized. The lecture timetable scheduling is still mostly done manually due to its technical difficulties. The manual scheduling of lecture-timetable required considerable time and efforts. The lecture-timetable scheduling is constraints satisfaction problem in which we find an optimal solution that satisfies the given set of constraints.

The primary objective in preparing timetable is obtaining conflict free for each activity sharing the same resources. Most of the method faces difficulties in generating a feasible timetable which faces long processing period without complying with several conditional constraints. The aim of the project is to create timetable in an efficient way which will be conflict free and abiding by all the constraints.

3.1 Need:

In any educational institution, creating a timetable or scheduling the classes and other activities is of prime importance but is a very tedious process and to overcome this worry, So we have developed an automated timetable management system. Developed with a user-friendly interface, the timetable management system uses algorithms to generate subject and course combinations. The timetable management system plays a crucial role in creating a structured timetable for classes across subjects. The timetable management software prioritizes different subjects and also gives the option to modify allotment based on requirements. The basic aim of the timetable management system is to optimize resource allocation and reduce manpower and time wasted in creating an error free schedule with zero data clashes. The software for the timetable management can be used to ensure the most effective time schedules are fixed according to the college's needs and suggestions.

3.2 Constraints:

Constraints are the fundamental elements of a timetable that the software use to create the timetable and must be abided by. We want to develop an algorithm for developing an effective and practical timetabling algorithm which will satisfy constraints. We primarily focused on developing algorithm which is easy to implement without compromising on its effectiveness and performance. As represented by the constraints designing a timetable is a very complex job. For this reason, creating a reliable automatic server which requires no manual intervention is a very difficult problem and most organizations do not have such a solution. Instead, most timetables are created manually by expert administrator who has deep knowledge of all requirements of all parties involved.

3.2.1 Hard constraints: All hard constraints must be followed, no hard constraints can be violated in any case.

1. A classroom is not assigned to more than one lecture at same time.
2. An instructor cannot teach more than one subject at the same time.
3. Two Courses for the same year-session students of a department cannot take place at same time except for elective subject in theoretical class and two different labs for which department are divided into sub groups may be scheduled together.
4. The lectures are not allotted to time slots which come under the lecturer's prohibited time zones.
5. Practical subjects can start from 1st, 2nd and 5th period only and are held for 3 hours continuously so they end on 3rd, 4th and 7th period respectively.

3.2.2 Soft Constraints: It is desirable to satisfy all soft constraints but may be sacrificed to find a feasible timetable.

1. Practical classes of 4th year should get first preference and must be scheduled in the first half i.e. first four periods.
2. All non-laboratory classes should be scheduled in the second half i.e. last 3 periods for any year.
3. A subject should not have more than one class on a particular day.
4. Two consecutive classes should not be taken by same teacher.
5. One subject should not assign more than once in one day.
6. There should not be off period in between.
7. One teacher should have a non-teaching day in a week.
8. Theoretical Classes should not be in second half.

3.3 Functionality:

In our project we have three end users.
1) Admin
2) Head of the Department
3) Faculty

- Admin is provided with following features:

- Generate timetable: Only admin has the right to generate the timetable using the system. No one else can generate timetable.
- View timetable: Admin can view his or her own timetable as well as student timetable and lab timetable.
- Add user: Admin can add a new user of the system and can give the user the login credentials to access the system.
- View user details: Admin can view the details of all the users who are using the system.
- Update user details: Admin can update a user's record.
- Delete user: If a user leaves the college or by in any case the user is not a valid user then to delete his or her information admin is provided with this feature.
- Add lab: If a new lab is built in college then to add that lab into the database admin will need this feature.
- Insert Department: If the college opens a new department then in order to add those details the admin will need this feature.

- Head of the Department is provided with following features:

- View timetable: HOD can view his or her own timetable as well as student timetable and lab timetable.
- Assign subject to faculty: HOD can assign a subject to faculty considering the faculty's preference list. HOD have to choose faculty from those who have given the subject as their choice.
- Assign lab to faculty: HOD can assign lab to faculties. Faculty's available teaching hour will be deducted by three hour and at least three faculty should be assigned in one lab.
- Update subject Details: If university change any subject's details then in order to modify old subject records HOD is provided with this feature.
- Insert subject: If university add any subject in a course then in order to store new subject record in the database this feature will be required.
- Delete Subject: : If university remove any subject in a course then in order to remove that subject record from the database this feature will be required.

- Faculty is provided with following features:

- View Timetable: Faculty can view his or her timetable. To know in which day and in which period he or she has classes and which periods are free period.
- Give subject preference: Faculty can choose subjects from university subject list and can enlist those as preferred subject. Subject will be assigned to faculty depending on the subject choices.

3.4 Nonfunctional requirements:

In systems engineering and requirements engineering, a non-functional requirement is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions. For example, attributes such as performance, security, usability, compatibility aren't a "feature" of the system, but are a required characteristic.

In our project nonfunctional requirements are:

- Dynamicity in management.
- Automate the manual work
- Platform independence
- Availability of updated data.
- Authentication to authorized user.
- The System should be reliable.

3.5 Functional Requirements:

Functional requirements define the fundamental actions that system must perform. The functional requirements for the system are divided into three main categories, User, Subject/Classes/Semester, and Master Timetable Management.

- User Management:-

  - The system records registrations.

    Input: -Registration details.

    Output: -Registration successful.

  - The system updates all details of user.

    Input: -Enter id and new record.

    Output: -Updated successfully.

  - The system deletes details of user.

    Input: -Enter id.

    Output: -Deleted successfully.

  - The system displays all details of user.

    Input: -See details.

    Output: -All details of user

  - Retrieve the member information.

Input: -Enter the member id.

Output: -Retrieve the details.

- Login Management:-
  - Login function provides the login to member and managed authentication .The system shall track login details.

  Input: - Username and password.

  Output: - Login successfully/Wrong username or password.

- Timetable Generation module:-
  - The system will show timetable year and department wise.

  Input: - Details of subject, faculty, lab.

  Output: -Timetable.

  - The system shall track all details about lab.

  Input: - Lab number.

  Output: - Show details about lab timetable

  - Faculty can see his/her timetable.

Input: - Faculty id.

Output: - Show details about his/her timetable

- Subject Management:-
  - The system displays records of all subjects.

  Input: -Enter subject code.

  Output: - Show details about subject.

  - The system records the subjects' details.

  Input: Subject details.

  Output: -Recorded successfully.

- The system records the labs' details.

  Input: Lab details.

  Output: -Recorded successfully.

- The system deletes subject details.

  Input: - Enter subject id.

  Output: - Deleted successfully.

- The system updates subject details.

  Input: - Enter subject id and new records.

  Output: - Updated successfully.

- Subject Preference Management:-
  - The system provides faculties to enter their subject preference which they want to teach.

    Input: -Enter preferences.

    Output: - Recorded successfully.

- Subject Assignment Management:-
  - The system provides HOD to assign teacher to subject.

    Input: - Enter assign details.

    Output: - Recorded successfully.

  - The system provides HOD to assign teacher to lab.

    Input: - Enter assign details.

    Output: - Recorded successfully

3.6. Assumptions

The application is designed for St. Thomas' College of Engineering and Technology on that basis following assumptions are made while designing the system:

1. Classrooms are assigned to each year and department manually for their theoretical lecture.
2. Classes are held from 9:30am -5:30pm on weekdays and have 7 periods for lectures/labs to be assigned excluding recess time.
3. Classes are held from 9:30am -1:45pm on Saturday and have 4 periods for lecture/labs to be assigned excluding recess time.

4. On some days classes may start late or finish early so starting or ending periods can be empty.
5. Faculties are assigned the subjects they will teach by Head of the Department manually.

4. Design and Methodology

In design methodology part Data Flow Diagram, Entity Relationship diagram, detail design of tables used and the screenshots of the software is given in order to understand clearly. To understand more accurately what are the features of the system and how the system is designed this section will be helpful.

In Data Flow diagram it is shown that how the data is flowing through the entire system. How input data are processing and output are obtained. Processes are also shown in Data flow Diagrams. Processes are subdivided into sub processes for simplicity purpose. To understand data flow properly Data stores are also present in Data Flow Diagram.

In Entity Relationship diagram the different entities of our system are shown and relationship among them is also shown. How each entity is associated with another entity is clearly mentioned in ER diagram. **ER diagrams** illustrate the logical structure of databases.

In Database design part the detail design of the tables are present. The table schema ,integrity constraints used, Referential constraints used, attributes of the table are mentioned. **Database design** is the process of producing a detailed data model of database. This data model contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a data definition language, which can then be used to create a database.

In **screenshot** part the screenshots of the software are attached to understand properly how the system is designed and how it is working.

4.1 Data Flow Diagram

A **data flow diagram (DFD)** is a graphical representation of the flow of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated. We have given and discussed level 0 and level 1 DFD of our system below.

A context diagram is a top level (also known as "Level 0") data flow diagram. It only contains one process node that generalizes the function of the entire system in relationship to external entities .They do not contain data stores.

4.1.1 Data Flow Diagram Level 0:

In level 0 DFD the system, Users and data flow is mentioned. Entire system is considered as a process and there is only one process node in the figure. This process node generalizes the function of the entire system in relationship to external entities. External entities are end users of the system. Arrows coming out from the system are denoting output data and arrow towards the system are denoting input data. As level 0 Data Flow Diagram does not contain data stores so no database is mentioned here. Data stores are shown in next levels of Data Flow Diagram.

Our system timetable Management System is the process node. It is the main process. Users are admin, Head of the department and faculties. They are mentioned as external entities who can use the system.

Input data are those which users are providing to the system and system is processing those data and generating output data. Output data are the outputs system is producing after processing the input data.

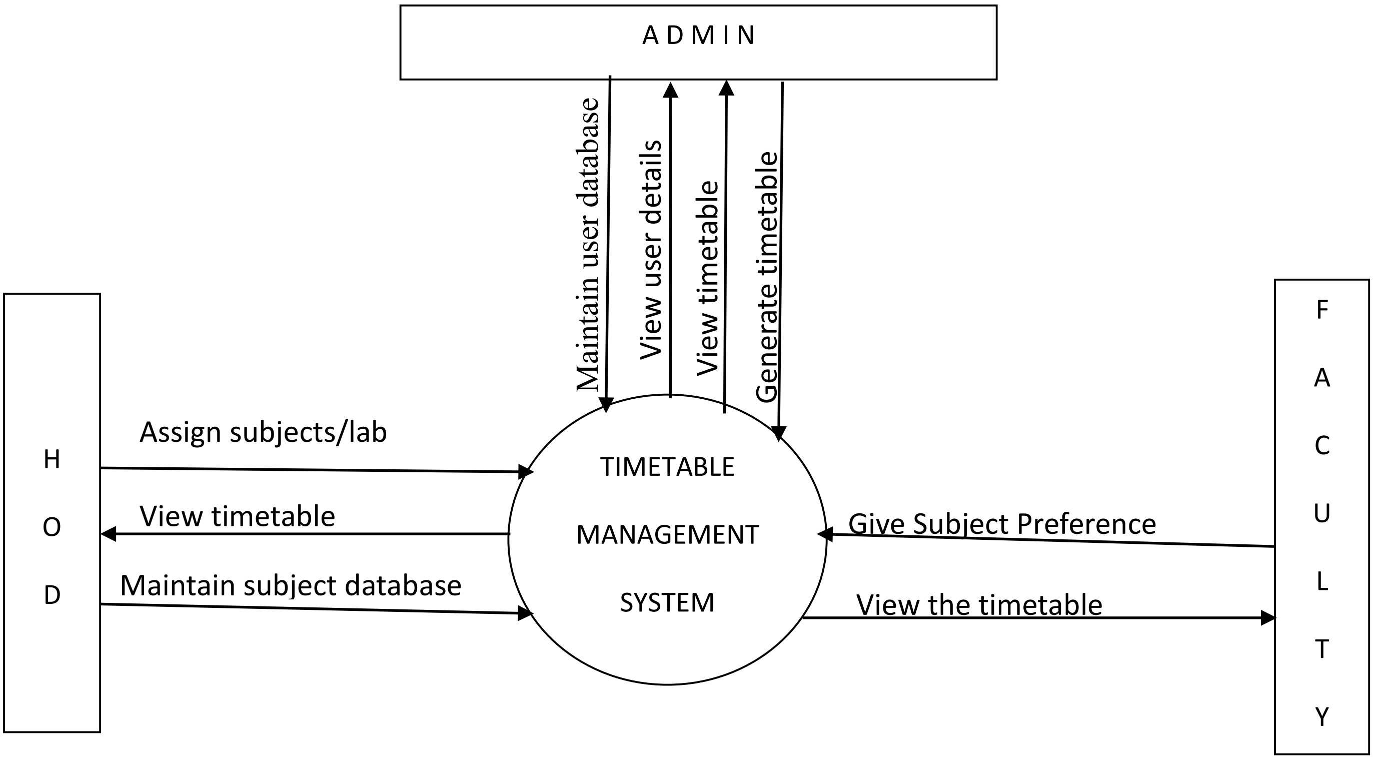


Figure 2: Data Flow Diagram Level 0

4.1.2. Data Flow Diagram Level 1:

In level 1 DFD the main process is subdivided into multiple sub-processes to simplify the system design. Sub-processes are numbered to understand properly. Entities are there and Data stores are also present in level 1 DFD. Input data are denoted by arrows going towards processes and output data are mentioned by arrows coming out of processes.

User gives input using different processes and then after processing those data it is stored in data stores. When user want to fetch data user uses processes to access data from data stores. How data are flowing which data is flowing all are mentioned in the DFD in details.

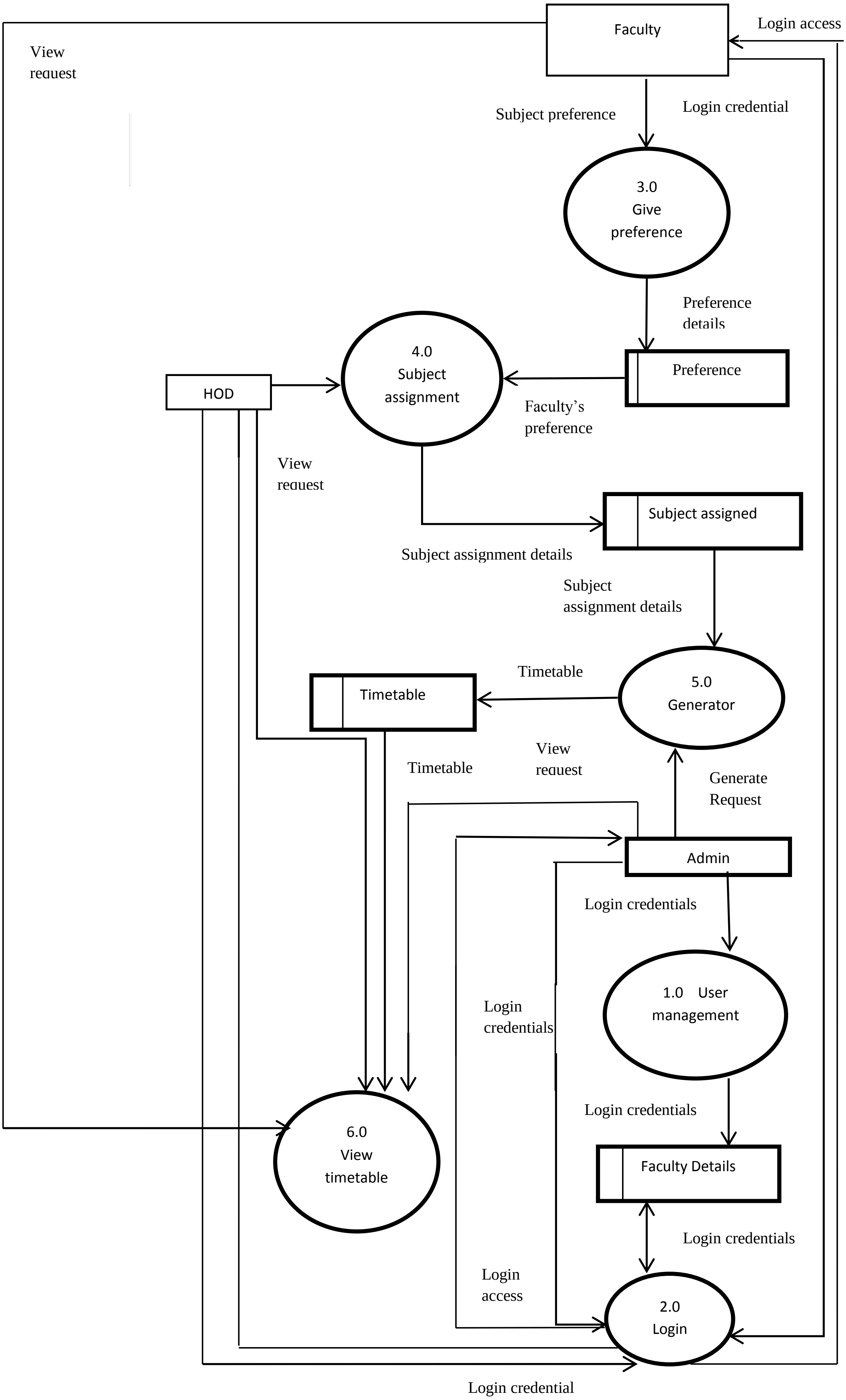


Figure 3: Data Flow Diagram Level 1

4.2 Entity Relationship Diagram

An **entity relationship** model, also called an **entity-relationship** (**ER**) **diagram**, is a graphical representation of **entities** and their **relationships** to each other, typically used in computing in regard to the organization of data within databases or information systems.

Entities are represented by means of rectangles. Rectangles are named with the entity set they represent. Attributes are the properties of entities. Attributes are represented by means of ellipses. Every ellipse represents one attribute and is directly connected to its entity (rectangle).To make the diagram look clear attributes are listed below. Relationships are represented by diamond-shaped box. Name of the relationship is written inside the diamond-box. All the entities (rectangles) participating in a relationship, are connected to it by a line. Cardinality is the number of instance of an entity from a relation that can be associated with the relation.

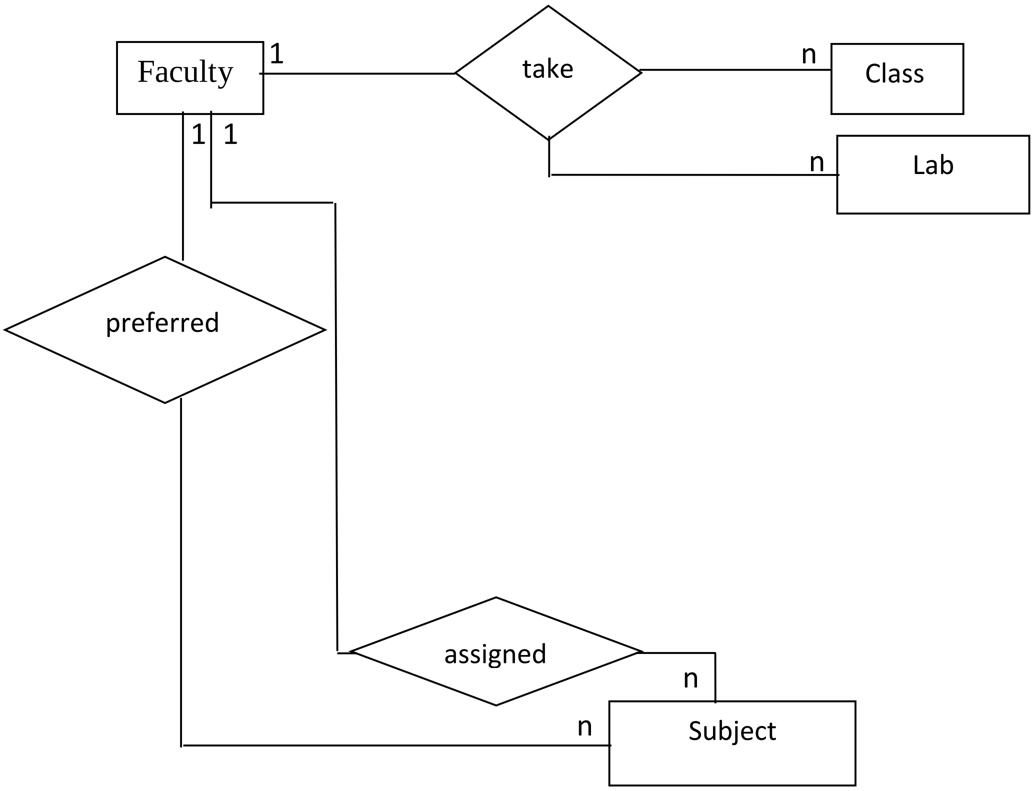


Figure 4: Entity Relationship Diagram

4.2.1. Attribute

- Faculty(FacultyId, Name, Password, Post, Teaching_hours, Admin_rights)
- Class(Year, Dept, Semester, Period)
- Subject(Code, Sub_name, Semester, Theory, Practical)
- Lab(Name, Code)

4.3 Database Design

TABLE: FACULTY

Field Name	Type	Field Properties	Description
FID	Int	Primary key	Faculty ID
F_FIRSTNAME	Varchar	Not null	password
F_LASTNAME	Varchar	Not null	Faculty Name
F_PASSWORD	Varchar	Not null	password
ADMINRIGHTS	Varchar	'Y' or 'N'	Admin rights
POST	Varchar	Foreign key (TEACHER_POST)	Post of faculty
DEPARTMENT	Varchar	Not null	Department of faculty

TABLE: FACULTY_POST

Field Name	Type	Field Properties	Description
POST	Varchar	Primary key	Faculty's Post
TEACHING_HOURS	Int	Not null	Teaching Hours

TABLE: SUBJECT

Field Name	Type	Field Properties	Description
S_ID	Varchar	Primary key	Subject ID
DEPARTMENT	Varchar	Primary key	Department
SUBJECT_NAME	Varchar		Subject Name
SEMESTER	Int		Semester number
THEORTICAL	Int		Number of theory class
PRACTICAL	Int		Number of practical class
TUTORIAL	Int		Number of tutorial class

TABLE: PREFERENCE

Field Name	Type	Field Properties	Type
FIRST	Varchar		Name of the 1st subject
SECOND	Varchar		Name of the 2nd subject
THIRD	Varchar		Name of the 3rd subject
FOURTH	Varchar		Name of the 4th subject
FIFTH	Varchar		Name of the 5th subject
SIXTH	Varchar		Name of the 6st subject
F_ID	Int	Foreign key(faculty)	Id of faculty
DEPARTMENT	Varchar		Name of the 1st subject

TABLE: ASSIGN

Field Name	Type	Field Properties	Description
S_ID	Varchar	Foreign key(SUBJECT)	Subject ID
F_ID1	Int	Foreign key(FACULTY)	Faculty ID
THEORITICAL1	Int		
F_ID2	Int		
THEORITICAL2	Int		
TUTORIAL 1	Int		
TUTORIAL2	Int		
DEPARTMENT	Varchar		Department

TABLE: LAB

Field Name	Type	Field Properties	Description
LAB_ID	Varchar	Foreign key (SUBJECT)	Subject ID
DESCRIPTION	Varchar		Facuty ID
DEPT	Varchar		Department

TABLE: ASSIGNLAB

Field Name	Type	Field Properties	Description
LABCODE	Varchar	Foreign key(Lab)	Subject code
FID1	Int		Faculty Id
FID2	Int		Faculty Id
FID3	Int		Faculty Id
FID4	Int		Faculty Id
LABNAME	Varchar		Name of the lab
DEPARTMENT	Varchar		Department

TABLE: S_TIMETABLE

Field Name	Type	Field Properties	Description
DAY	Varchar	Primary Key	Day of the week
PERIOD	Int	Primary Key	Period of the day
SEMESTER	Int	Primary Key	Year of class
DEPARTMENT	Varchar	Primary Key	Department of class
S_ID	Varchar	Foreign Key	Subject

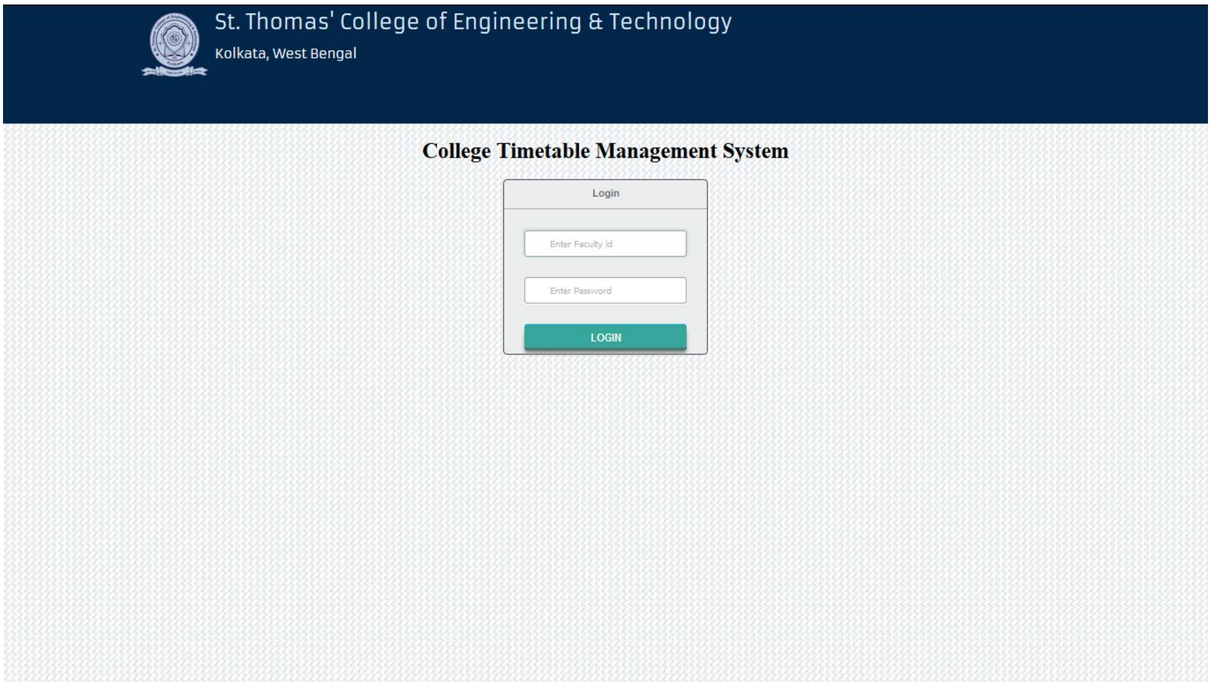
TABLE: TEACHERTIMETABLE

Field Name	Type	Field Properties	Description
DAY	Varchar	Primary Key	Day of the week
PERIOD	Int	Primary Key	Period of the day
DEPARTMENT	Varchar	Primary Key	Department of class
S_ID	Varchar	Foreign Key	Subject
F_ID	Int	Foreign Key	Teacher

TABLE: DEPT

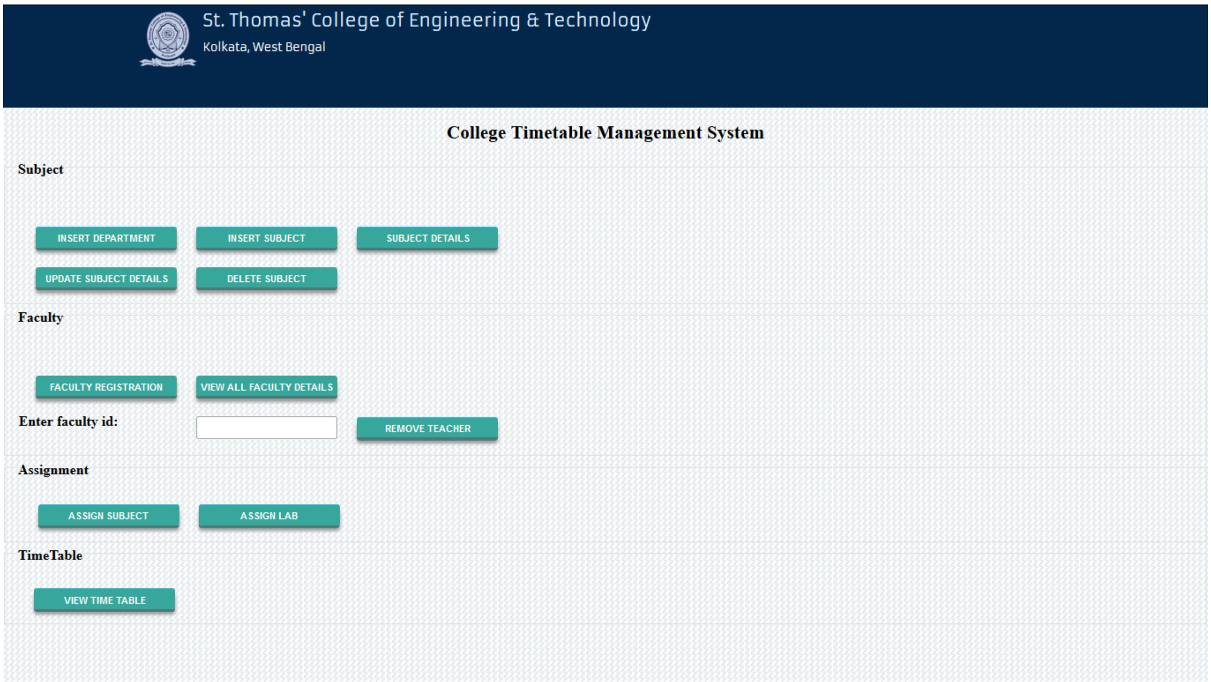
Field Name	Type	Field Properties	Description
DEPARTMENT_ID	Int	Primary Key	ID of Department
Department	Varchar	Unique	Department Name

4.4 FRONT END


St. Thomas' College of Engineering & Technology
Kolkata, West Bengal

College Timetable Management System

Figure 5: Login Page for College Timetable Management System


St. Thomas' College of Engineering & Technology
Kolkata, West Bengal

College Timetable Management System

Subject

Faculty

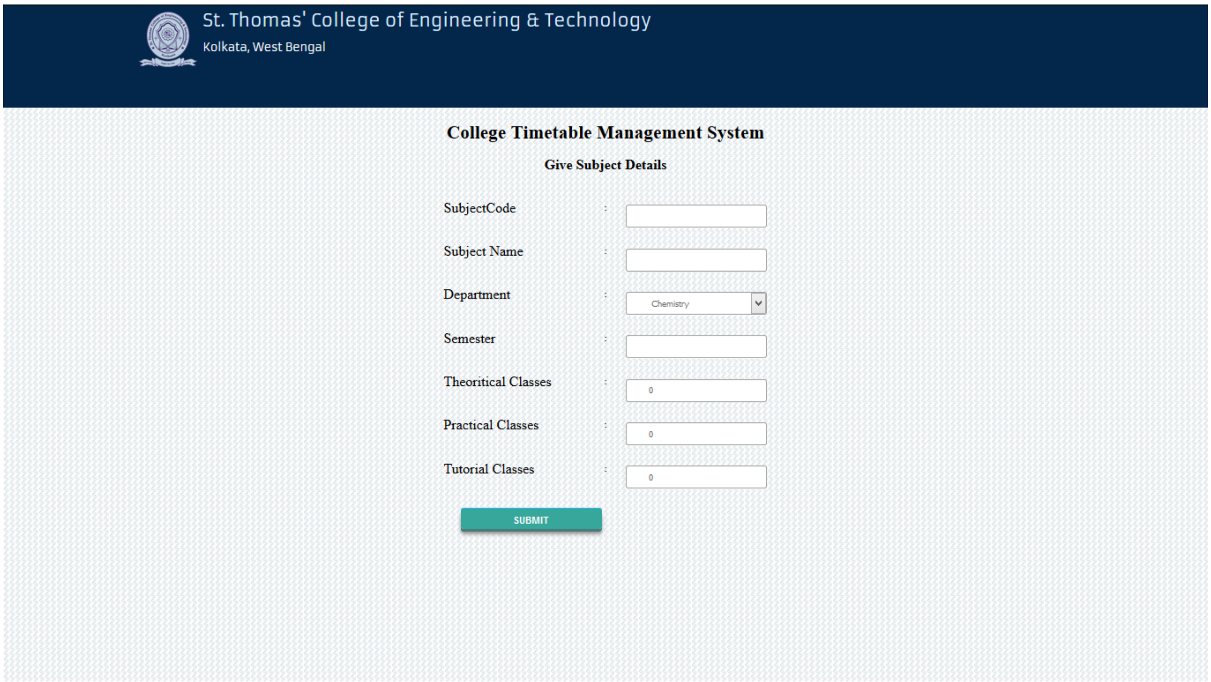
Enter faculty id:

Assignment

TimeTable

Figure 6: Home page for admin

Figure 5 shows the login page have faculty id and password as fields and figure 6 shows the home page after Head of the Department logs in the system having access to insert, update, remove a subject along with faculty registration and removing faculty. The assign tab allows subjects and labs to be assigned.



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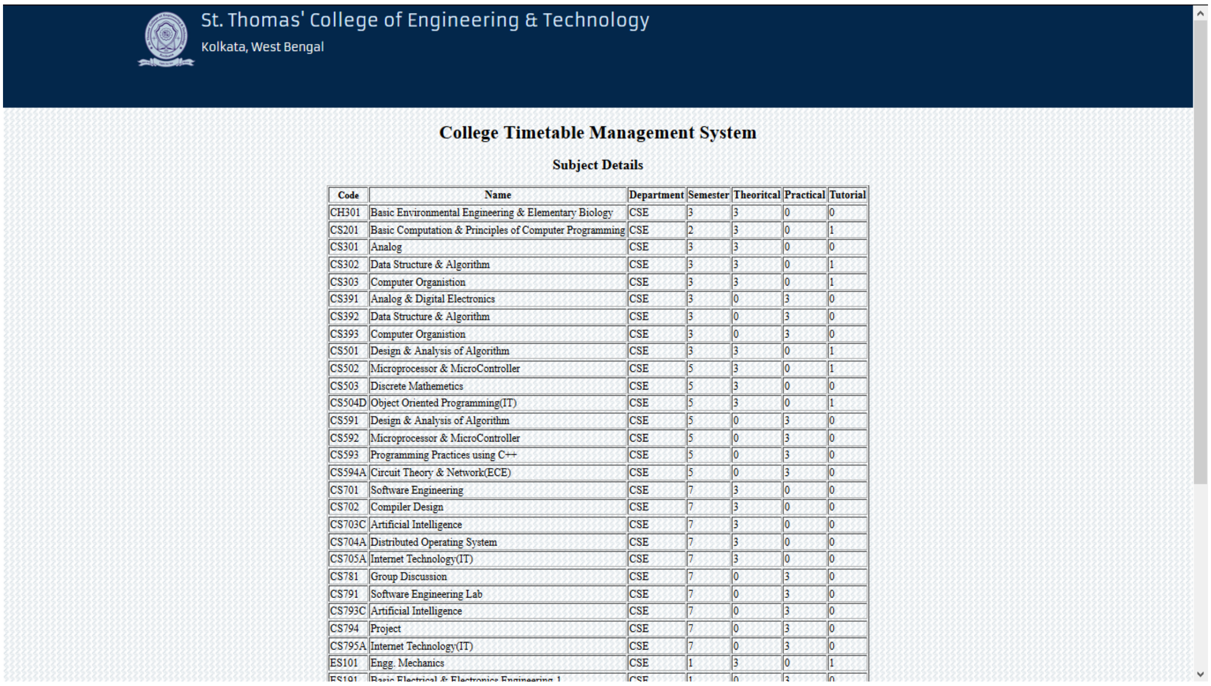
Kolkata, West Bengal

College Timetable Management System

Give Subject Details

SubjectCode :
Subject Name :
Department : Chemistry
Semester :
Theoritical Classes : 0
Practical Classes : 0
Tutorial Classes : 0

Figure 7: Page for adding new Subject



St. Thomas' College of Engineering & Technology
Kolkata, West Bengal

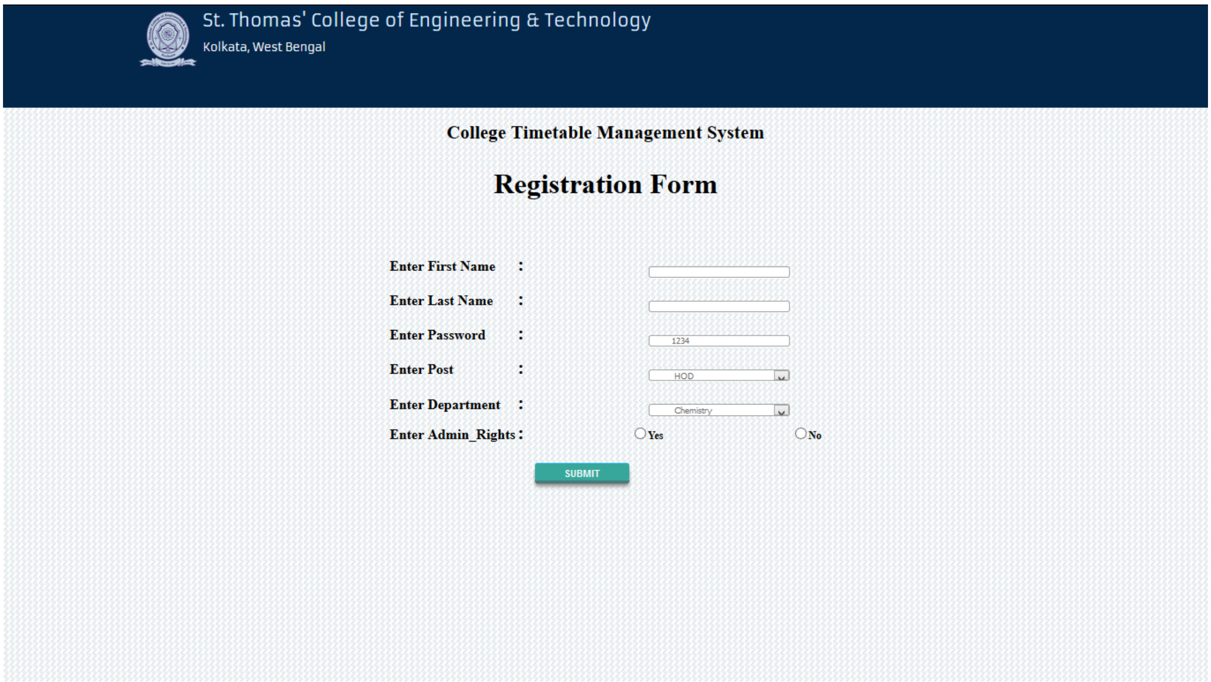
College Timetable Management System

Subject Details

Code	Name	Department	Semester	Theoritcal	Practical	Tutorial
CH301	Basic Environmental Engineering & Elementary Biology	CSE	3	3	0	0
CS201	Basic Computation & Principles of Computer Programming	CSE	2	3	0	1
CS301	Analog	CSE	3	3	0	0
CS302	Data Structure & Algorithm	CSE	3	3	0	1
CS303	Computer Organistion	CSE	3	3	0	1
CS391	Analog & Digital Electronics	CSE	3	0	3	0
CS392	Data Structure & Algorithm	CSE	3	0	3	0
CS393	Computer Organistion	CSE	3	0	3	0
CS501	Design & Analysis of Algorithm	CSE	3	3	0	1
CS502	Microprocessor & MicroController	CSE	5	3	0	1
CS503	Discrete Mathemetics	CSE	5	3	0	0
CS504D	Object Oriented Programming(IT)	CSE	5	3	0	1
CS591	Design & Analysis of Algorithm	CSE	5	0	3	0
CS592	Microprocessor & MicroController	CSE	5	0	3	0
CS593	Programming Practices using C++	CSE	5	0	3	0
CS594A	Circuit Theory & Network(ECE)	CSE	5	0	3	0
CS701	Software Engineering	CSE	7	3	0	0
CS702	Compiler Design	CSE	7	3	0	0
CS703C	Artificial Intelligence	CSE	7	3	0	0
CS704A	Distributed Operating System	CSE	7	3	0	0
CS705A	Internet Technology(IT)	CSE	7	3	0	0
CS781	Group Discussion	CSE	7	0	3	0
CS791	Software Engineering Lab	CSE	7	0	3	0
CS793C	Artificial Intelligence	CSE	7	0	3	0
CS794	Project	CSE	7	0	3	0
CS795A	Internet Technology(IT)	CSE	7	0	3	0
ES101	Engg. Mechanics	CSE	1	3	0	1
ES191	Basic Electrical & Electronics Engineering 1	CSE	1	0	3	0

Figure 8: Subject Details for all the subjects in the database

Figure 7 shows the page to add a new subject to the database the following fields are taken subjects code, subject name, department the subject will be taught, semester corresponding to the subject followed by number of theortical, practical and tutorial classes. Figure 8 shows the list of subjects which are present in the database.



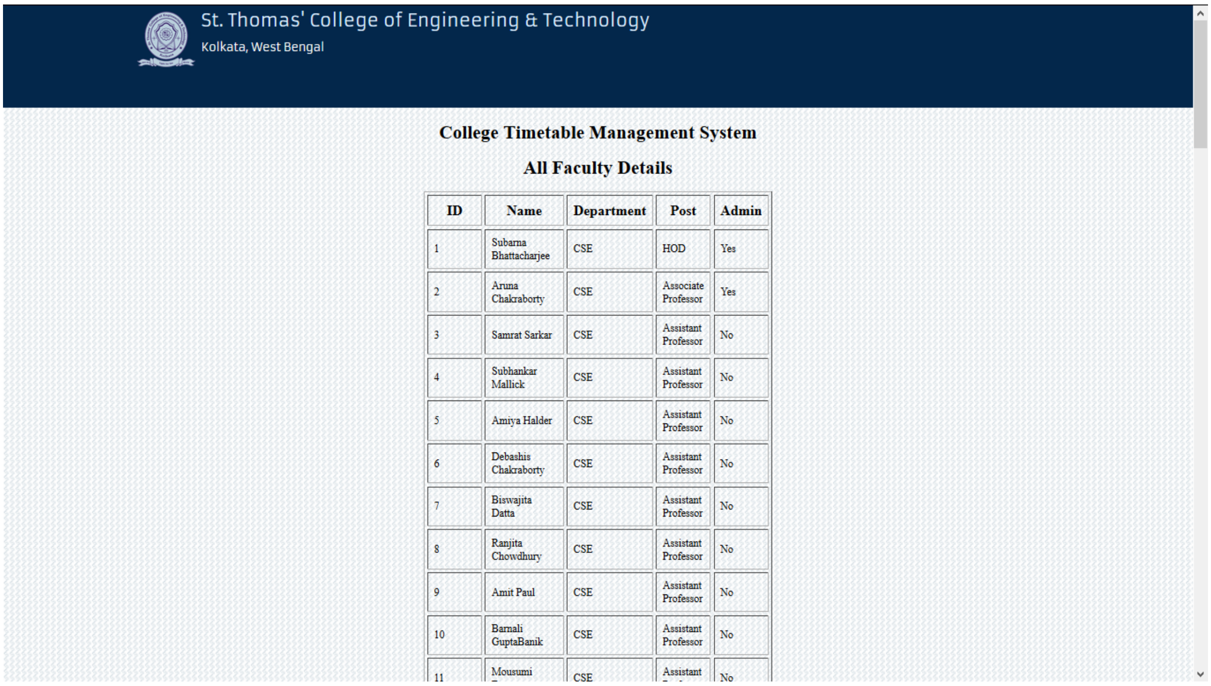
St. Thomas' College of Engineering & Technology
Kolkata, West Bengal

College Timetable Management System

Registration Form

Enter First Name :
Enter Last Name :
Enter Password : 1234
Enter Post : HOD
Enter Department : Chemistry
Enter Admin_Rights : ○ Yes ○ No

Figure 9: Add new faculty to the Database



St. Thomas' College of Engineering & Technology
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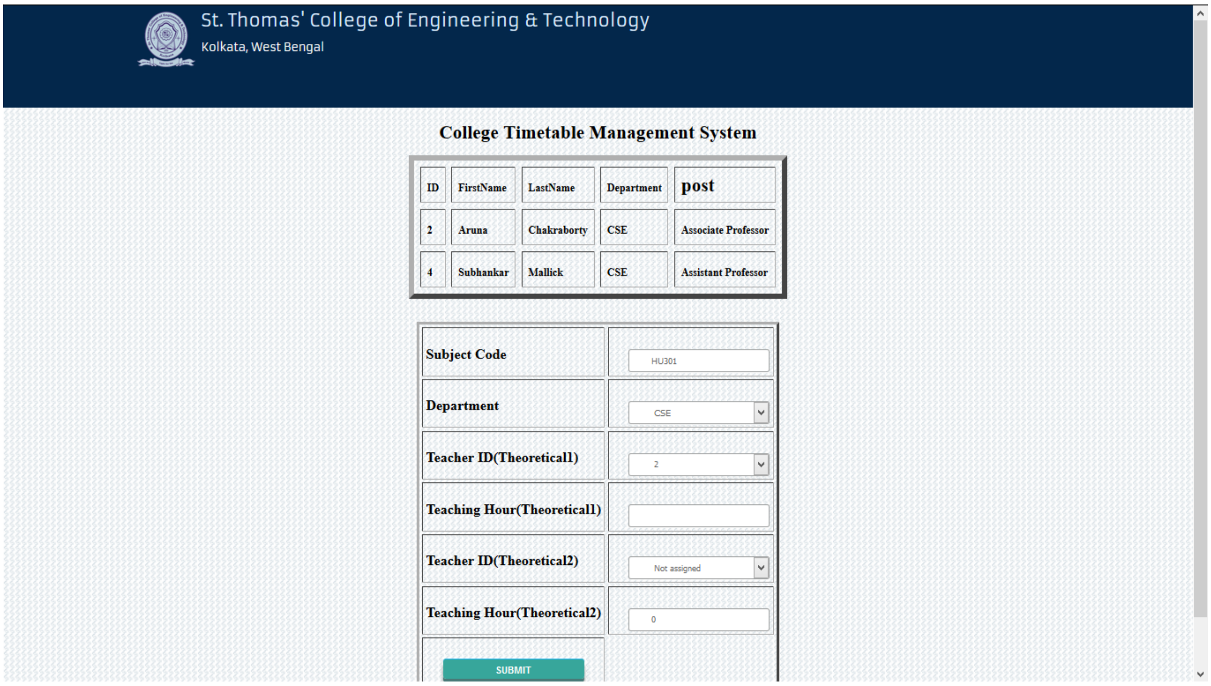
College Timetable Management System

All Faculty Details

ID	Name	Department	Post	Admin
1	Subarna Bhattacharjee	CSE	HOD	Yes
2	Aruna Chakraborty	CSE	Associate Professor	Yes
3	Samrat Sarkar	CSE	Assistant Professor	No
4	Subhankar Mallick	CSE	Assistant Professor	No
5	Amiya Halder	CSE	Assistant Professor	No
6	Debashis Chakraborty	CSE	Assistant Professor	No
7	Biswajita Datta	CSE	Assistant Professor	No
8	Ranjita Chowdhury	CSE	Assistant Professor	No
9	Amit Paul	CSE	Assistant Professor	No
10	Barnali GuptaBanik	CSE	Assistant Professor	No
11	Mousumi	CSE	Assistant	No

Figure 10: Database View of all the faculty details

Figure 9 shows registration form for adding a new faculty by the head of the department or admin which takes first name, last name, password is by default set to 1234 unless supplied, the designation/post has the following options HOD, Assistant Professor, Associate Professor and guest lecture, the department field to keep a faculty to a department and make assigning easier. Admin rights is generally not given to a faculty unless he has a role in timetable management. Figure 10 shows the list of faculty present in the system database along with all the fields mentioned excluding the password.



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College Timetable Management System

ID	FirstName	LastName	Department	post
2	Aruna	Chakraborty	CSE	Associate Professor
4	Subhankar	Mallick	CSE	Assistant Professor

Subject Code	HU301
Department	CSE
Teacher ID(Theoretical1)	2
Teaching Hour(Theoretical1)	
Teacher ID(Theoretical2)	Not assigned
Teaching Hour(Theoretical2)	0
SUBMIT	

Figure 11: Page for assignment of Subject

After the faculty gives their preference, figure 11 shows the subject assignment page in which Head of the department assigns all the faculty along with the number of hours to each faculty from the list above the page and assign it to teacher.

5.Sample Code

Code of class definition in java:

```
public class Subject {
            String subjectID;
            int sem;
            String dept;
            int deptcode;
            int year;
            String subjectName;
            int theortical;
            int practical;
            int tutorial;
}

class Sclass{
    int sem;
    int year;
    String dept;
    Subject[][] timetable=new Subject[6][7];
    Sclass()
    {
            for(int i=0;i<6;i++){
                        for(int j=0;j<7;j++){
                                    timetable[i][j]=new Subject();
                        }
            }
                        for(int i=4;i<7;i++)
                        {
                                    timetable[5][i].subjectID="X"; //Represents classes cannot be alloted.
                        }
    }
}
class Teacher
{
        String name;
        String tID;
        Subject[][] timetable=new Subject[6][7];
        int teaching_hours;
        LinkedList<Subject> subQ =new LinkedList<Subject>();
        Teacher()
        {
                for(int i=0;i<6;i++)
                {
                for(int j=0;j<7;j++)
                {
                        timetable[i][j]=new Subject();
                }
        }
        for(int i=4;i<7;i++)
                timetable[5][i].subjectID="X";
        }
        public void notavailable(int day,int start_period,int end_period)
        {
                        for(int i=start_period;i<=end_period;i++)
                        {
                                timetable[day][i].subjectID="X";
                        }
        }
        private boolean non_teachingday(int day){
                for(int i=0;i<6;i++)
                {
                        for(int j=0;j<7;j++){
```

```
{
            if(timetable[i][j].subjectID!=null&&timetable[i][j].subjectID!="X")
                    break;
            if(j==7)
                return false;
        }
    }
    return true;
}
public  int first_period(){
    int day=0;
    for(int i=0;i<6;i++)
    {
        if(timetable[i][0].subjectID!=null && timetable[i][0].subjectID!="X")
            day++;
    }
    return day;
}
private float day_ratio(int day)
{
    int unassigned=0,assigned=0;
    for(int j=0;j<7;j++)
    {
        if(timetable[day][j].subjectID==null)
            unassigned++;
        else
            assigned++;
    }
    return ((float)unassigned/(assigned+unassigned));
}
public int max_day_ratio()
{
    float max=-1,x;
```

```
                int day=6,free_day=-1;
                for(int i=0;i<6;i++)
                {
                        x=day_ratio(i);
                        if(x>max)
                        {
                                if(x==1 && free_day==-1)
                                {
                                        free_day=i;
                                }
                                else
                                {
                                   max=x;
                                   day=i;
                                }
                        }
                }
                if(max==0)
                        return free_day;
                else
                        return day;
        }
}
public class Lab
{
        String labName;
        Subject[][] timetable=new Subject[6][7];
        LinkedList<Subject> labQ =new LinkedList<Subject>();
        int labmax=10;
        Lab()
        {
                for(int i=0;i<6;i++)
        {
        for(int j=0;j<7;j++)
        {
            timetable[i][j]=new Subject();
        }
    }
        for(int i=4;i<7;i++)
            timetable[5][i].subjectID="X";
    }
}
```

Code for Assignment of Subjects to Teachers

assignSubject.jsp

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<%@  include file="/Header & Background.html"  %>
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>Insert title here</title>
</head>
<body>
<form action="AssignSubjectServlet" method="get">
<table align="center">
<tr><td>Enter Subject</td>
<td><input type="text" name="subject"></br></td></tr>
<tr><td><input type="submit" value="submit"></td></tr>
</table>
</form>
</body>
</html>
```

Code of Teacher’s Subject Preference

GivePreference.jsp

```
<%@page import="com.Bean.FacultyBean"%>
<%@page import="com.Dao.SubjectDao"%>
<%@page import="com.Dao.SubjectDaoImpl"%>

<%@page import="com.Bean.SubjectBean"%>
<%@page import="java.util.ArrayList"%>
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
```

```
<%@  include file="/Header & Background.html"  %>
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>Give Preference</title>
</head>
<body>
<%
Object ob= session.getAttribute("faculty");
FacultyBean fbean=(FacultyBean)ob;

%>
<form action="givePreferenceServlet" method="post">
<table>
<tr><td></td><td>:</td><td><input type="text" name="fid" value=<%=fbean.getF_Id()
%>hidden="hidden">
<tr><td></td><td>:</td><td><input type="text" name="department" value=<%= fbean.getDepartment()
%>hidden="hidden">
<tr><td>1st Prefernce</td><td>:</td><td><select name="Subject1">

<%
	SubjectDao sd1= new SubjectDaoImpl();
	ArrayList<SubjectBean> sb1=sd1.getAllSubjectName();

	if(sb1.size()>0){

		for(SubjectBean sb:sb1){
			%>
			<option><%=sb.getsId() %></option>


		<%}} %>

</select></td><tr>
<tr></tr>
<tr><td>2nd Prefernce</td><td>:</td><td><select name="Subject2">

<%
	SubjectDao sd2= new SubjectDaoImpl();
	ArrayList<SubjectBean> sb2=sd2.getAllSubjectName();

	if(sb1.size()>0){

		for(SubjectBean sb:sb2){
			%>
			<option><%=sb.getsId()%></option>


		<%}} %>

</select></td><tr>
<tr></tr>
<tr><td>3rd Prefernce</td><td>:</td><td><select name="Subject3">
```

```
<%
        SubjectDao sd3= new SubjectDaoImpl();
        ArrayList<SubjectBean> sb3=sd3.getAllSubjectName();

        if(sb1.size()>0){

                for(SubjectBean sb:sb3){
                        %>
                        <option><%=sb.getsId() %></option>


                <%}} %>

</select></td><tr>
<tr></tr>
<tr><td>4th Prefernce</td><td>:</<td><select name="Subject4">

<%
        SubjectDao sd4= new SubjectDaoImpl();
        ArrayList<SubjectBean> sb4=sd4.getAllSubjectName();

        if(sb1.size()>0){

                for(SubjectBean sb:sb4){
                        %>
                        <option><%=sb.getsId()%></option>


                <%}} %>

</select></td><tr>
<tr></tr>
<tr><td>5th Prefernce</td><td>:</<td><select name="Subject5">

<%
        SubjectDao sd5= new SubjectDaoImpl();
        ArrayList<SubjectBean> sb5=sd5.getAllSubjectName();

        if(sb1.size()>0){

                for(SubjectBean sb:sb5){
                        %>
                        <option><%=sb.getsId() %></option>


                <%}} %>

</select></td><tr>
<tr></tr>
<tr><td>6th Prefernce</td><td>:</<td><select name="Subject6">

<%
        SubjectDao sd6= new SubjectDaoImpl();
        ArrayList<SubjectBean> sb6=sd6.getAllSubjectName();
```

```
            if(sb1.size()>0){

                        for(SubjectBean sb:sb6){
                                    %>
                                    <option><%= sb.getsId() %></option>


                        <%}} %>

</select></td><tr>


<tr><td></td><td><input style="height:30px; font-size: 6; width : 161px;" type="submit"
value="Submit"></td></tr></table>

</table>
</form>
</body>
</html>
```

givePreferenceServlet.java

```
package com.Srv;


import java.io.IOException;

import java.io.PrintWriter;


import javax.servlet.ServletException;

import javax.servlet.annotation.WebServlet;

import javax.servlet.http.HttpServlet;

import javax.servlet.http.HttpServletRequest;

import javax.servlet.http.HttpServletResponse;

import com.Bean.GivePreferenceBean;

import com.Dao.GivePreferenceDAO;


@WebServlet("/givePreferenceServlet")

public class givePreferenceServlet extends HttpServlet {

            private static final long serialVersionUID = 1L;

   public givePreferenceServlet() {

      super();

   }
```

```
	protected void doGet(HttpServletRequest request, HttpServletResponse response) throws ServletException, IOException {
		PrintWriter out=response.getWriter();
		GivePreferenceBean bean=new GivePreferenceBean();
		bean.setFirst(request.getParameter("Subject1"));
		bean.setSecond(request.getParameter("Subject2"));
		bean.setThird(request.getParameter("Subject3"));
		bean.setFourth(request.getParameter("Subject4"));
		bean.setFifth(request.getParameter("Subject5"));
		bean.setSixth(request.getParameter("Subject6"));
		bean.setDepartment(request.getParameter("department"));
		String fid=request.getParameter("fid");
		int facultyid=Integer.parseInt(fid);
		bean.setFid(facultyid);
		GivePreferenceDAO calldao=new GivePreferenceDAO();
		boolean b=calldao.insertData(bean);
		if(b==true)
			out.println("Inserted Successfully");
		else
			out.println("error");
	}
	protected void doPost(HttpServletRequest request, HttpServletResponse response) throws ServletException, IOException {
		// TODO Auto-generated method stub
		doGet(request, response);
	}


}
```

GivePreferenceDao.java

```
package com.Dao;


import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.PreparedStatement;
import java.sql.SQLException;

import com.Bean.GivePreferenceBean;

public class GivePreferenceDAO {
    private Connection con=null;
    public static Connection getMySQLConnection()throws
ClassNotFoundException,SQLException
    {
        Class.forName("com.mysql.jdbc.Driver");
        Connection con =
DriverManager.getConnection("jdbc:mysql://localhost:3306/FinalYear","root","monalisa");
        System.out.println("Connected");

        return con;
    }
    public boolean insertData(GivePreferenceBean ob)
    {
        boolean f= false;
        try
        {
            con = getMySQLConnection();
            PreparedStatement pst= con.prepareStatement("insert into preference
values(?,?,?,?,?,?,?)");
            {
                pst.setString(1, ob.getFirst());
                pst.setString(2, ob.getSecond());
                pst.setString(3, ob.getThird());
                pst.setString(4, ob.getFourth());
                pst.setString(5, ob.getFifth());
                pst.setString(6, ob.getSixth());
                pst.setInt(7, ob.getFid());
                pst.setString(8, ob.getDepartment());
                int i1=pst.executeUpdate();
                if(i1>0)
                    f=true;
            }
        }catch(Exception e)
            {System.out.println(e.toString());}
        finally
        {
            try
            {
                con.close();
            }
            catch (SQLException e)
            {
                e.printStackTrace();
            }
        }
        return f;
    }
}
```

6. Testing, Results, Discussion on Results:

An error is a human action that produces an incorrect result. A fault is a manifestation of an error in software (also known as a defect or bug). A fault, if encountered may cause a failure, which is deviation of the software from its expected delivery or service. Reliability is the probability that the software will not cause the failure of a system for a specified time under specified conditions. Errors occur because we are not perfect and, even if we were, we are working under constraints such as delivery deadlines.

6.1 Testing

Testing identifies faults, whose removal increases the software quality by increasing the software's potential reliability. Testing is the measurement of software quality. We measure how closely we have achieved quality by testing the relevant factors such as correctness, reliability, usability, maintainability, reusability, testability, etc.

In this page both individual components and an integrated component are methodically verified to ensure they are error free and fully meet the requirement. Test cases are used to confirm that whether the system works perfectly under all expected input types.

6.1.1 User Management Module:

The user management module allows new faculty to be added and remove the existing teacher. The following test cases were checked:

1. Add a new faculty
   - The first name was tested with numerical values, special characters none of them were accepted. A message was shown only letters are allowed.
   - The last name was also tested with numerical values, special characters none of them were accepted. A message was shown only letters are allowed.
2. Remove a faculty
   While removing a faculty, faculty id is used. If the faculty id is not present or is missing then a pop error message is shown.

6.1.2 Login Module:

A pop up message is shown for incorrect login credentials. Login module doesn't display whether the login id is wrong or the password is wrong. Login doesn't happen for the following combination:

- Correct faculty id and incorrect password.
- Incorrect faculty id and correct password.
- Incorrect faculty id and incorrect password.

6.1.3 Subject Preference Module:

The Preference module allows Faculty to give preference of the subjects. Faculty can give choices of only those subjects present in database.

6.1.4 Subject Assignment Module:

The assignment module allows Head of the Department only to assign the subjects and teaching hours to faculty.

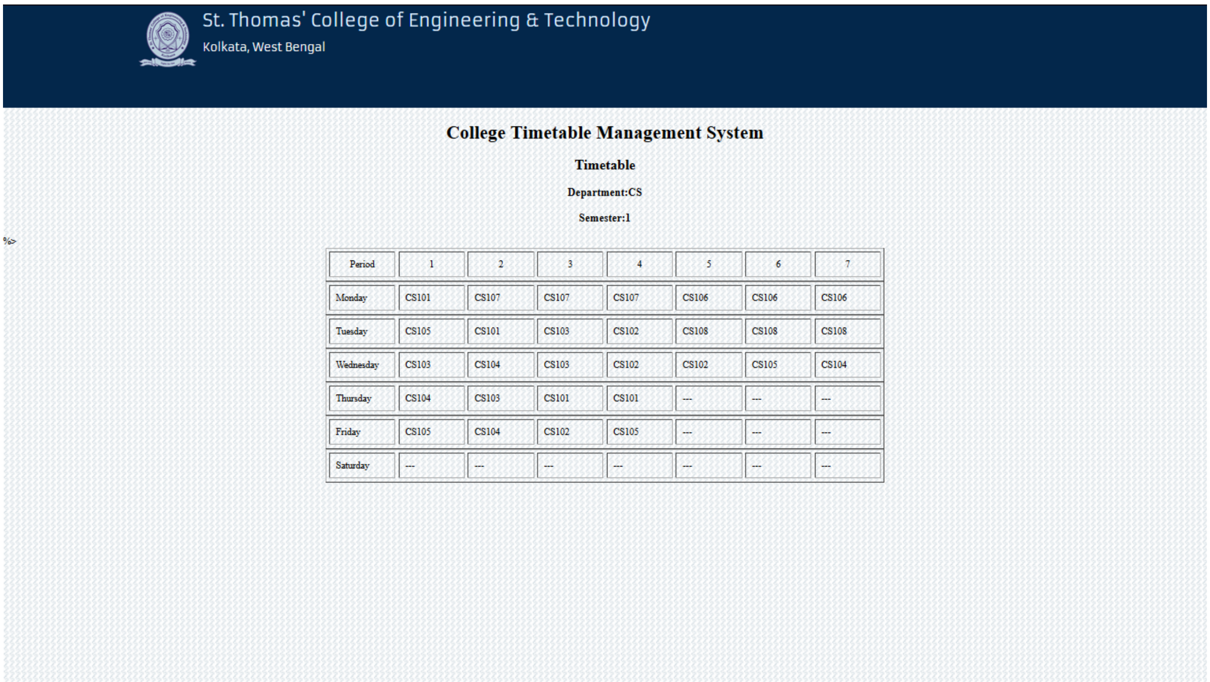
Assign subjects to teacher: While assigning teacher to subjects the teacher should have enough teaching hour left to teach the subject and the summation of the number of teaching hours assigned to the subject should be equal to the total teaching hours.

6.1.5 Timetable Generation Module:

The generation module is checked using an auto assign function which automatically assigns different subject to different teacher and different lab. It was checked several times the following were the result of the test case:

- The algorithm never went into an infinite loop; a timetable was always generated for all the randomized input.
- Soft Constraint was satisfied for over 75% of the total assignment for generation of timetable in all the test cases.

6.2 Result



St. Thomas' College of Engineering & Technology

Kolkata, West Bengal

College Timetable Management System

Timetable

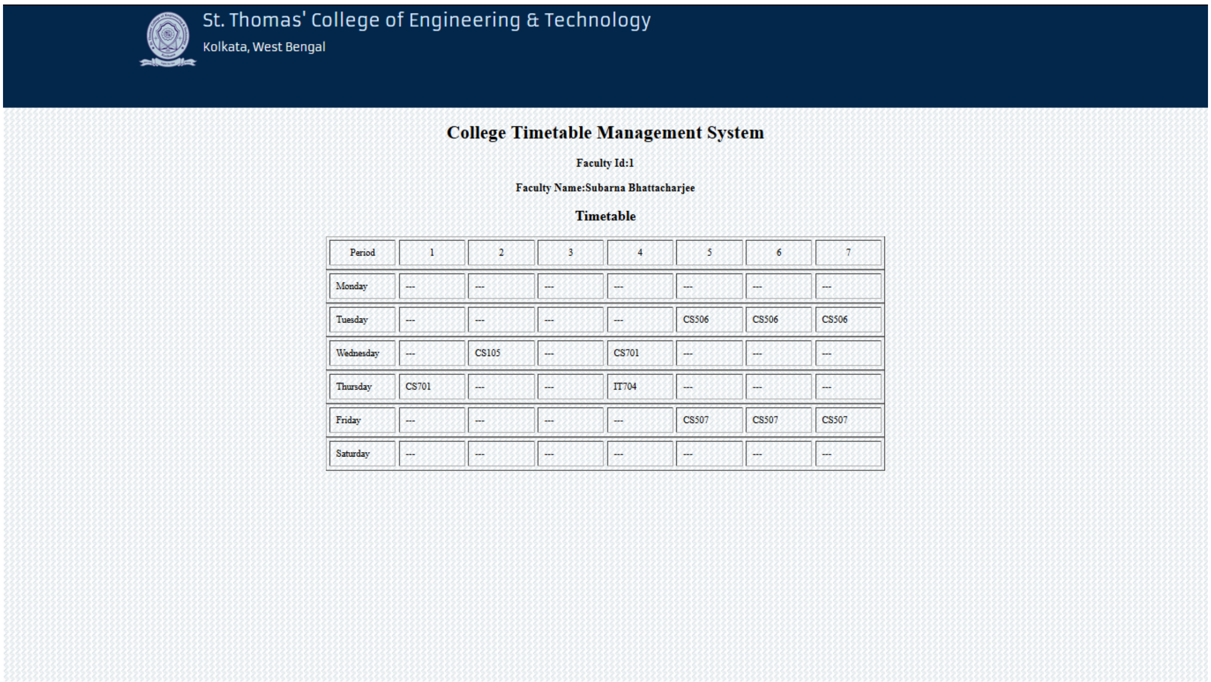
Department:CS

Semester:1

%>

Period	1	2	3	4	5	6	7
Monday	CS101	CS107	CS107	CS107	CS106	CS106	CS106
Tuesday	CS105	CS101	CS103	CS102	CS108	CS108	CS108
Wednesday	CS103	CS104	CS103	CS102	CS102	CS105	CS104
Thursday	CS104	CS103	CS101	CS101	---	---	---
Friday	CS105	CS104	CS102	CS105	---	---	---
Saturday	---	---	---	---	---	---	---

Figure 12: Page displaying timetable for students



College Timetable Management System

Faculty Id:1

Faculty Name:Subarna Bhattacharjee

Timetable

Period	1	2	3	4	5	6	7
Monday	---	---	---	---	---	---	---
Tuesday	---	---	---	---	CS506	CS506	CS506
Wednesday	---	CS105	---	CS701	---	---	---
Thursday	CS701	---	---	IT704	---	---	---
Friday	---	---	---	---	CS507	CS507	CS507
Saturday	---	---	---	---	---	---	---

Figure 13: Page for displaying timetable for teachers

6.3 Discussion on Result

The timetable obtained in figure 12 and figure 13 satisfied the following features :

- There was no off period between two classes for students.
- Most faculty got a non-teaching day for research works.
- No faculty had class on first period more than 3 days.
- No hard constraint was violated while few of the soft constraints were violated for few cases.

7. Conclusion:

The primary objective in preparing timetable is obtaining conflict free for each activity sharing the same resources. Most of the method faces difficulties in generating a feasible timetable which faces long processing period without complying with several conditional constraints. The aim of the project is to create timetable in an efficient way which will be conflict free and abiding by all the constraints.

Future Work

- ✓ Leave Management module to assign substitute teacher when one teacher is on leave or absent.
- ✓ Room Management for tutorial/elective subjects.
- ✓ Assigning a teacher to more than one department for a combined class of more than one department.
- ✓ Adding more Soft constraint to the timetable.

8. Reference:

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3. Dinkel,J,J.,Mote,J., & Venkataraman, M.A.(1989). An efficient decision support system for academic course scheduling.
4. Database System Concepts by Avi Silberschatz,Henry F.Korth & S.Sudarshan.
5. Fundamentals of Database System by Elmasri Navathe.