Course Description (Goals & Objectives):

Course Objective
Today, we live in the age of the Knowledge society after passing through the Information society. In other words, enterprises need to make use of massive information available, make a quick decision, and focus on comparative advantages they hold, in order to survive in the competitive market. To this end, database is what they need to ensure an effective and efficient management of corporate data. Database plays a role only for storage of simple data in the beginning stage. Therefore, this course aims to help students, the first-time learners of database, improve their understanding of data base by introducing basic concepts of database related items related and exploring related case studies.

Course Overview
This course will focus on theory of database by offering mainly lectures, and team presentation is also required in order to encourage students’ voluntary participation in class.

Course Outline:
- **Week 1**
  - Orientation
    - Provide details of grading mechanism
    - Provide overall guidelines of database classes that will be offered throughout a semester
    - Overall description of database

  Chapter 1 Database environment
Students will gain understanding of what role database plays in corporations or organization, and how it works
Lecturer provides descriptions of five types of database and their key elements
Connection between database and ERP that is currently used by many corporates, and how it works
Basic concept and definition of database
- Difference between data and information
- Roles and definitions of metadata
Database management system
Basic understanding of data model’s roles and modeling

- **Week 2**

  Chapter 1 Database environment

  Basic concepts of relational database
  - It will be discussed in Chapter 3, Chapter 5, and Chapter 9 in detail.

  Concepts and functions of traditional file system

  Disadvantages of file system
  - Program and data dependency
  - Data redundancy
  - Limited data sharing
  - Long-term development hours
  - Excessive program maintenance

  Database access method
  - Explain advantages of database access method, such as program – data dependency, planned data redundancy, data consistency improvement, data sharing improvement, productivity enhancement of application development, more strictly applied standards, data quality improvement, reduction of maintenance efforts, and supporting making a decision process improvement

  Lecturing on elements of database environment and application category of database

  Development process of database system
  
  Chapter 2 Database development process

  Students will learn life cycle of system development project by focusing on goals of each process related to database analysis, design, and implementation.

  - Students will learn database development in the context of information system development (information system architecture, information engineering, planning information system)
- Study on system development life cycle
- Offering instructions on enterprise data modeling, conceptual data modeling, logical database design, physical database design and definitions, database implementation, and database maintenance

Students will learn a prototyping approach for database and application development
- Study on the prototyping approach among several alternative IS development approaches
- Study on the prototyping approach and database development process

Offering instructions on the agile software development approach for database and application development
- Lecture on a variety of elements required for agile software development
- Students will study universal data model and industry-specific model

● Week 3

Chapter 1 Database development process

Lecturing on roles of individuals in charge of design, implementation, using, and management of database
- Explain various roles of human resources required for entire process starting with an initial stage of project to the maintenance
- Human resource management of database development

Lecturing on differences among external schema, conceptual schema, and internal schema for database, and significance of Three-schema architecture
- Characteristics and required elements for Schema
- Provide information on schema required for each stage, including analysis, logical design, and physical design stage.
- Study on elements of Three-schema

Study on roles of productized data model in the database development

Study on the three-tier architecture for database and database processing
- Offering instructions on client tier, application/web server tier, and company-wide sever tier that make up the three-tier database architecture

Study on the scope of project related to database design and development

Study on preparing simple data model showing the scope of database

Chapter 3 Data modeling of Organization

Lecture on why many system developers believe that modeling is the most important part of
- Modeling on rules of organization
- Study on basic concepts of business rules
- Explain characteristics of advisable business rules

Study on definitions of entity, relationship, and attributes
- Study on data names and definitions methods
- Study on “what is the definition of desirable data”

● Week 4

Chapter 4 Data modeling of Organization
Students will learn how to classify the three relationships, unary, binary, and ternary, and then study general examples of each relationship respectively.
- Study basic overview of E-R model
- Study on the degree of relationship

The course offers instructions on the following elements of ERD and modeling design
- Composite attribute, multivalued attribute, derived attribute, associative, identifying relationship, minimum and maximum cardinality constraints
- Students will obtain an understanding of entity and attributes, and then learn basic concepts and theory of relationship modeling

Students will learn how to draw ERD that expresses general business situations.
- Foundational knowledge regarding E-R model notation and modeling for entity and attributes
- Converting a many-to-many relationship to an associative entity
- Modeling time-dependent data modeling

Multiple relationship
- Naming and defining relationship
- Modeling simple time-dependent data using time stamps

Chapter 4 Extended E-R model and business rules
- How to recognize when supertype/subtype relationship is necessary in data modeling
- Extended relationship model
- Definitions and notations of supertype and subtype
- Basic concepts of case tools and notation using them including MS Visio

How to use both specialization and generalization as techniques to define supertype and
subtype relationship
- Characteristics and roles of attributes inheritance
- Supertype/subtype relationship notation
- Setting constraints in the supertype and subtype relationship
- Specialization and generalization notation
- Specialization and generalization coupling

● Week 5

Chapter 4 Extended E-R model and business rules
- Students will learn completeness constraint and non-overlapping constraint when modeling supertype and subtype relationship
- Students will learn definition and traits of completeness constraint
- Students will learn total specialization rules and partial specialization rules, methods to define completeness constraint
- Non-overlapping constraint rules
- Overlapping rules
- Non-overlapping subtype
Drawing tier architecture of supertype and subtype for real business situations
  - Definitions of supertype/subtype tier architecture

Chapter 4 Extended E-R model and business rules
Students will learn how to draw entity cluster in order to simplify E-R diagram
- Definition of entity cluster and how to use it
- Understanding EER diagram using entity cluster
- Understanding definition of universal data model
Students will be able to name various categories of business rules
- Roles of derive, structural declaration, and declaration that are used for business rules
- Notation of Structural declaration
- Notation of behavioral declaration
- Business rule notation and implementation

Chapter 5 Logical database design and relational model
Students will learn five characteristics of relationship
-History and background of relational data model
- Data structure and data integrity
- Basic concepts of relational data structure and relational keys
- Characteristics of relationship

Students will learn essential traits of candidate key
- Definitions and roles of candidate key

Week 6

Chapter 5 Logical database design and relational model

Describe the data normalization process
- Introduction and characteristics of data normalization
- Normalization process (First normal form, second normal form, third normal form, Boyce-Codd normal form (BCNF), fourth normal form, fifth normal form)
- Functional dependency

Explain problems that can occur during coupling relationships
- Repeating group removal, partial functional dependency, transitive dependency removal

Explain how to transform E-R diagram into an equivalent set of relations

Explain how to draw relational tables where entity integrity constraint and referential integrity constraint are coupled

How to use normalization in order to decompose ill-structured relations into well-structured relations

Normalization process using examples
- Advanced work needed when transforming views into tables
- Repeating group removal and choosing primary key
- Improve understanding of determinant and normalization
- Learn problems of view integration

- Week 7

Chapter 6 Physical database design and functions

Explore physical database design process and its objectives
- Physical database design process
- To learn various information needed for physical files and database design
- To learn Storage format required for decision making process regarding physical database design, physical record, file composition, index and database architecture, and database
structure
- Data capacity and usage analysis

Students will learn how to choose storage format for attributes from logical data model
- Fields design and data type selection
- Data integrity control

Explain how to make a right choice for file structure in order to facilitate various important design factors are well organized
- To learn precautions, opportunities, and types of non-normalization
- Pros and cons of data fragmentation
- Definition and features of horizontal fragmentation
- Explain the three horizontal fragmentations, key scope fragmentation, hash fragmentation, and mixed fragmentation.
- Definition and features of Vertical fragmentation
- Explain a possible non-normalization situation through examples

Describe major file organization
- Definition and concept of file organization
- Definition of sequential file organization
- Definition of index file organization

Explain objective of index and major considerations when selecting attributes to be used for index
- Concept and features of index
- To learn definitions and traits of four types index; unique primary index, non-unique primary index, unique secondary index, and non-unique secondary index
- Bitmap index and join index

Explain how to convert relational data model into an effective database structure, and also explain when and how logical data model should be non-normalized

- **Week 8**
  Mid-term exam

- **Week 9**
Chapter 7 Overview of SQL
Explain history and roles of SQL in the database development
- Creation background and development process of SQL
- History of SQL standard
- Roles of SQL in the database architecture
- SQL environment, such as Catalogue and Schema etc.
- Functions and how to use DDL (Data Definition Language), DML (Data Manipulation Language), and DCL (Data Control Language)

Explain how to define database using SQL DDL (Data Definition Language)
- Creating SQL database definitions

Explain how to write single table queries using SQL command language
- To learn SELECT commands
- To learn the conditional with WHERE clause
- How to use SELECT commands using numbers and function
- How to retrieve data using wild card and comparison operators
- How to use logical operators and scope operators
- Array and grouping results of commands using Order by and Group by

Students will learn how to set referential integrity using SQL
- Concept of referential integrity
- How to create data integrity control
- Modify definitions of tables using Alter command language
- Delete tables using Drop command language
- Change of data using Update, insert, Delete command languages

Discussions regarding SQL-92 and SQL-99 standards

- **Week 10**

Chapter 8 Advanced SQL

Students will learn how to write queries for single table and multiple tables using SQL command languages
- Basic concepts of JOIN which is required for multiple tables rather than single table

Explain definitions of three types of JOIN command language and how to use SQL in order to write the command language
- How to use EQUI JOIN
- How to use NATURAL JOIN
- How to use OUTER JOIN
Explain how to write correlated subquery and uncorrelated subquery
- Basic definitions and how to use correlated subquery and uncorrelated subquery
- Examine into derived table
Students can set referential integrity using SQL.
Explain general usage of database trigger and stored procedure
- Definition and features of stored procedure
- Understanding data dictionary and how to use it
  Discuss SQL-99 standard and explain what features have been extended and
  strengthened compared to SQL-92
- User-defined data type
- Proposed Analytic function
- Extension of programing
- Basic concepts of trigger and routine and how to use them
- Differences between function and procedure

● **Week 11**

Chapter 9 Client/Server database environment
Explain various major advantages of client/server architecture compared to other
computing approaches
- Concepts of Client/Server architecture
- Understanding concepts of file server architecture
- Explain limits of file server
- Database server architecture
Students will learn three elements of application program; communication service,
processing service and storage service
Also, they will learn the scope of techniques to fragmentize these services in various
types of client/server architecture.
Draw a distinction between file server architecture, database server architecture, three-
tier architecture, and n-tier architecture
- Definition and details of Fat client
- Definition and details of Thin client
- Definition and advantages of three-tier architecture
Students will learn definition of middleware and how middleware triggers client/server
architecture
Functions of query interface using examples and its relationship with Microsoft Access 2002, and its advantages and disadvantages by comparing it with SQL

Explain how to connect external data table to application program of client/server environment using ODBC and JDBC.

Students will learn how to use VBA along with Microsoft Access 2002 in order to build client application program

- **Week 12**
  
  Chapter 10 Internet database environment
  
  Explain importance of connecting database to web page.
  
  - Operating database based on today’s internet environment
  
  - Learn database system suitable for internet environment
  
  Students will learn basic environment that needs to be arranged in order to set connectivity of internet and intranet database
  
  - Elements of intranet and the scope of provided service
  
  - Explain internet related language

  Objectives and achievements of World Wide Web Consortium

  Objectives of XML and how to use XML to standardize data interpretation on the web
  
  - Server extension
  
  -Web server interface, interoperability, and interactivity

  Explain how Mpath can support XQuery and how to use XQuery to navigate through the XML structure

  Describe web services and make a comparison between web server interfaces including
  
  Java servlet regarding issues related to successful arrangement of web service in the e-commerce.

  - To learn concepts of service-oriented architecture

  - To understand Semantic Web

  Describe three methods to balance load of web server

  Explore plug-in

- **Week 13**

  Chapter 11 Data Warehouse

  Examine two important factors that caused “information gap” to exist between demand
Explore two main reasons that most enterprises in today’s world need data warehouse:
- To learn definitions of basic concepts of data warehouse; subject-oriented, integrated, time-variant, and non-renewable
- Enterprise-wide data view, a high-quality data view required by enterprises
- Separating operation system from information system

Present three levels of data warehouse architecture and explore them:
- Independent data mart and data warehouse environment
- Dependent data mart and operational data store architecture
- Logical Data mart and real-time Data warehouse architecture
- Three-tier data architecture

Two major elements of STAR Schema
- To learn definitions of fact table and dimension table
- To learn from examples of Star Schema

Estimate the number of lines of fact table and overall size based on byte unit under reasonable database dimension related assumption,

Explore how to design data mart through various steps such as normalizing /non-normalizing dimensions and explaining history to facts, relationship between dimensions and how to change dimension attributes value etc.
- Normalization of dimension table
- What is slowly changing dimension?
- How to determine dimension or fact

Explore how to develop requirements for Data mart from questions to support decision making process
  - Improving requirements using OLAP tool etc.

- Week 14

Chapter 12 Data quality and integration

Explain the importance of data quality and learn a variety of measures that can help improve quality
- Students will learn why data quality management is needed and its advantages, such as minimization of IT project risk, business related decision making in a timely manner, guarantee of rule compliance, and expansion of client base
Describe features of high quality data
- Students will learn definitions of elements needed to improve data quality, such as uniqueness, accuracy, consistency, completeness, timeliness, currency, conformity referential integrity, and then learn how they are related to high quality data

Examine why poor quality data is generated in an organization.
- Students will learn how poor quality data is generated using case studies, including original external data, storage of duplicate data, inconsistent meta data, data entering, and lack of participation from organization.

Describe programs for improving data quality of organization, including duties of data manager and management structure
- Students will learn how to improve data quality through various ways, such as data quality audit, improving data acquisition process, setting up data management program, TQM principles and examples, modern data management technology application, ROI estimation, and adopting high-quality data model.

Explore three data integration approaches
Explain objectives and roles of Master data management, one of data integration method
- General approaches to data integration
- Learn Master data management

Five steps of ETL process and its activities in data integration for data warehouse
- Definition and features of ETL
- ETL process

Explore various formats of data conversion required to prepare data for data warehouse
- What is data conversion?
- Functions of data conversion
- Tools supporting data adjustment

**Week 15**
Chapter 13 Data and database management

Data management and various major functions of database management
- Ineffective data management
- Effective data back-up and restoration

Explain role changes of data managers and database managers in the recent business
environment
- Traditional data management
- Selecting DBMS and its related software tool, DBMS installation and upgrade, database performance adjustment, improving performance of database query processing, data security, privacy and integrity management, data back-up and restoration
Roles of data dictionary and information repository and how they can be used in data management
Comparison between optimistic system and pessimistic system for concurrency control
Explain issues of database security and five techniques used to improve the security
Describe issues of database restoration and explain four basic tools included in DBMs to restore database
Describe issues of database adjustment carried out to achieve greater performance and then explain five areas that can change while adjusting database.
Describe the importance of data availability and explain various measures that can help improve availability

- Week 16
Final exam

Textbook(s):
Modern Database Management (9 edition) Scitech Media

Class Website: e-Class

Course Assignments & Grading:
- Mid-term exam 20
- Final exam 30
- Attendance 20
- Assignments 10
- Attitude 10
- Presentation 10