FF No. : 654

CS2227 ::Database Management Systems

Course Prerequisites: Data structures, Discrete Mathematics

Course Objectives:

1. Learn the fundamentals of different data modeling techniques.
2. Design and development of relational database management systems.
3. Study the theory behind database systems, the issues that affect their functionality and performance
4. Design of query languages and the use of semantics for query optimization.
5. Understand the latest trends of data management systems.

Credits: 4

Teaching Scheme Theory: 2 Hours/Week

Tut: NA

Lab: **2** Hours/Week

Course Relevance: The course emphasizes on the fundamentals of database modelling and design, the languages and models provided by the database management systems, and database ssystem implementation techniques. The goal is to provide an in-depth and up-to-date presentation of the most important aspects of database systems and applications, and related technologies.

SECTION-I
Topics and Contents **Introduction**: Need of Database Management Systems, Evolution, Database System Concepts and Architecture, Database Design Process **Data Modeling**: Entity Relationship (ER) Model, keys, Extended ER Model, , Relational Model, Codd's Rules; **Database Design**: Need of Normalization, Functional Dependencies, Inference Rules, Functional Dependency Closure, Minimal Cover, Decomposition Properties, Normal Forms: 1NF, 2NF, 3NF and BCNF, Multi-valued Dependency, 4NF **Query Languages**: Relational Algebra, SQL: DDL, DML, Select Queries, Set, String, Date and Numerical Functions, Aggregate Functions ,Group by and Having Clause, Join Queries, Nested queries, DCL, TCL, PL/SQL: Procedure, Function, Trigger, Mapping of Relational Algebra to SQL
SECTION-II

Topics and Contents

Storage and Querying: Storage and File structures, Indexed Files, Single Level and Multi Level Indexes; Query Processing, Query Optimization
Transaction Management: Basic concept of a Transaction, ACID Properties, State diagram, Concept of Schedule, Serializability – Conflict and View, Concurrency Control Protocols, Recovery techniques
Parallel and Distributed Databases: Architecture, I/O Parallelism, Interquery, Intraquery, Intraoperation and Interoperation Parallelism, Types of **Distributed** Database Systems, Distributed Data Storage, Distributed Query Processing
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Databases, Types of NOSQL Databases, BASE properties, CAP theorem, MapReduce.
Data Warehousing: Architecture and Components of Data Warehouse, OLAP

List of Practical: (Any Six)

1) Choose a database application; you propose to work on throughout the course. Perform requirement analysis in detail for the same. Draw an entity-relationship diagram for the proposed database.
2) Create a database with appropriate constraints using DDL and populate/modify it with the help of DML.
3) Design and Execute "SELECT" queries using conditional, logical, like/not like, in/not in, between...and, is null/is not null operators in where clause, order by, group by, aggregate functions, having clause, and set operators. Use SQL single row functions for date, time, string etc.
4) Write equijoin, non equijoin, self join and outer join queries. Write queries containing single row / multiple row / correlated sub queries using operators like =, in, any, all, exists etc. Write DML queries containing sub queries. Study a set of query processing strategies.
5) Write PL/SQL blocks to implement all types of cursor.
6) Write useful stored procedures and functions in PL/SQL to perform complex computation.
7) Write and execute all types of database triggers in PL/SQL.
8)Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.
9) Create a database with suitable example using MongoDB and implement Inserting and saving document, Removing document, Updating document
10) Execute at least 10 queries on any suitable MongoDB database that demonstrates following querying techniques:find and findOne, Query criteria, Type-specific queries
11) Implement Map Reduce operation with suitable example using MongoDB.

List of indicative project areas: (Any 1)

Following is the indicative list of projects but is not limited to. Student and teacher can also jointly decide project area other than specified in the list.

1. University/Educational institute database
2. Railway reservation/Show booking system
3. Finance management system
4. Travel/Tours management system
5. Blood bank management system
7. Sales management
8. Online retailer/payment systems
9. Hospital management system
10. Human resource management
11. Manufacturing/production management
12. Matrimonial databases for finding matches.
13. Online appointment booking

List of Course Seminar Topics:

1. Object and Object-Relational Databases
2. XML data model, XML documents and associated languages
3. Database Security
4. Modern Storage Architectures
5. Google Cloud- SQL Databases
6. Google Cloud- NOSQL Databases
7. Amazon Databases
8. Oracle NoSQL Database
9. Cassandra DB
10. Data Center Engineering
11. Google File System (GFS)

List of Home Assignments:

Design:

1. Suppose you want to build a video site similar to YouTube. Identify disadvantages of keeping data in a file-processing system. Discuss the relevance of each of these points to the storage of actual video data, and to metadata about the video, such as title, the user who uploaded it, tags, and which users viewed it.
2. Illustrate data model that might be used to store information in a social-networking system such as Facebook
3.Describe the circumstances in which you would choose to use embedded SQL rather than SQL alone or only a general-purpose programming language.
4. Give the DTD and XML Schema for Library Management System. Give a small example of data corresponding to this DTD and XML.Write ten queries in Xpath and XQuery
5.If you were designing a Web-based system to make airline reservations and sell airline tickets, which DBMS architecture would you choose? Why? Why would the other architectures not be a good choice?Design a schema and show a sample database for that application. What types of additional information and constraints would you like to represent in the schema? Think of several users of your database, and design a view for each.

Case Study:

1. PostgreSQL
2. Oracle
3. IBM DB2 Universal Database

4. Microsoft SQL Server
5. SQLite database

Blog
1.OLAP tools from Microsoft Corp. and SAP
2.Views in database
3. Dynamic SQL and Embedded SQL
4. Active databases and Triggers
5. SQL injection attack

Surveys
1. Keyword queries used in Web search are quite different from database queries. List key differences between the two, in terms of the way the queries are specified, and in terms of what is the result of a query.
2. List responsibilities of a database-management system. For each responsibility,explain the problems that would arise if the responsibility were not discharged
3. List reasons why database systems support data manipulation using a declarative query language such as SQL, instead of just providing a a library of C or C++ functions to carry out data manipulation
4. Consider a bank that has a collection of sites, each running a database system. Suppose the only way the databases interact is by electronic transfer of money between themselves, using persistent messaging.Would such a system qualify as a distributed database? Why?
5. Data warehousing products coupled with database systems

Suggest an assessment Scheme:
MSE:10 ESE:20 HA:10 CP:10 Lab:10 Seminar:20 CVV:20

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan; "Database System Concepts"; 6th Edition, McGraw-Hill Education
2. Ramez Elmasri, Shamkant B. Navathe; "Fundamentals of Database Systems"; 7th Edition, Pearson

Reference Books:

1. Thomas M. Connolly, Carolyn E. Begg," Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition ;Pearson
2. Raghu Ramakrishnan, Johannes Gehrke; "Database Management Systems", 3rd Edition; McGraw Hill Education
3. Kristina Chodorow, MongoDB The definitive guide, O'Reilly Publications, ISBN: 978-93-5110-269-4, 2nd Edition.
4. Dr. P. S. Deshpande, SQL and PL/SQL for Oracle 10g Black Book, DreamTech.
5. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication. 6. Reese G., Yarger R., King T., Williums H, Managing and Using MySQL, Shroff Publishers and Distributors Pvt. Ltd., ISBN: 81 - 7366 - 465 – X, 2nd Edition.
7. Dalton Patrik, SQL Server – Black Book, DreamTech Press.

8. Eric Redmond, Jim Wilson, Seven databases in seven weeks, SPD, ISBN: 978-93-5023-918-6.
9. Jay Kreibich, Using SQLite, SPD, ISBN: 978-93-5110-934-1, 1st edition.

Moocs Links and additional reading material:
https://nptel.ac.in/courses/106/105/106105175/
https://onlinecourses.nptel.ac.in/noc21_cs04/preview
https://www.datacamp.com/courses/introduction-to-sql
Oracle MOOC: PL/SQL Fundamentals - Oracle APEX

Course Outcomes:
The student will be able to –
1. Design data models as per data requirements of an organization
2. Synthesize a relational data model up to a suitable normal form
3. Develop a database system using relational queries and PL/SQL objects
4. Apply indexing techniques and query optimization strategies
5. Understand importance of concurrency control and recovery techniques
6. Adapt to emerging trends considering societal requirements

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO_1	3	2	3		2	3	2	2	2	2		
CO_2	2	3		3	3							
CO_3	3		3		3						2	3
CO_4	3	2			3	2						
CO_5	2	3		2								
CO_6	3					3	3					

CO attainment levels
CO1:5 CO2:4 CO3:3 CO4:5 CO5:4 Co6:5

Future Courses Mapping:
Advanced databases
Big Data Management
Cloud Databases
Database Administrator

Job Mapping:
Database Engineer
SQL developer
PL/SQL developer

Justification of Mapping:

CO1 – PO1: Strongly mapped as learning basics of designing data model and databases is the prime goal of subject and will be a key skill in the **engineering background.**

CO1 – PO2: Moderately mapped as for **problem analysis** using engineering approach designing of data models as per organization requirements is needed.

CO1 – PO3: Strongly mapped as **design/develop** data model as per specified need of organization need is required.

CO1 - PO5: Moderately mapped as use of appropriate **modern** engineering and IT **tools** for data model design is needed to modeling organizational requirement.

CO1 – PO6: Strongly mapped as for modeling and designing of data related to society using various data model is needed.

CO1 – PO7: Moderately mapped as designing of data using various data model is needed specifically for **societal problems and sustainable solutions**.

CO1 – PO8: Moderately mapped as designing of data is needed for solving critical problems to ensure ease of life by protecting professionalism and **ethics**.

CO1– PO9: Moderately mapped as designing of secure system by **individual or/and team** is needed to function effectively.

CO1 – PO10: Moderately mapped as to communicate effectively about organizational data storage need designing of data model is important.

CO2 – PO1: Moderately mapped as synthesizing of relational data model for normalization of data using engineering knowledge.

CO2 – PO2: Strongly mapped as analysis of data requirement and normalizing the data as per need using engineering approach is needed.

CO2 –PO4: Strongly mapped as studying normalization and synthesis of information into valid data.

CO2 - PO5: Strongly mapped as applying modern techniques data get normalized.

CO3 – PO1: Strongly mapped as development of data base system using relational queries and PL/SQL object engineering knowledge is needed.

CO3 – PO3: Strongly mapped as **design/develop** relation queries and PL/SQL object for fetching and storing of data to and from database.

CO3 – PO11: Moderately mapped as development of project by designing relational queries and PL/SQL object as individual or part of team at organization.

CO3 – PO12: Strongly mapped as data requirement is change over a time and as per data requirement development of relational queries and PL/SQL object needed **lifelong learning.**

CO4 – PO1: Strongly mapped as applying indexing techniques and query optimization engineering knowledge is needed.

CO4 – PO2: Moderately mapped as **analysis of problem** and determination of solution using query optimization technique using engineering approach is needed.

CO4 - PO5: Strongly mapped as apply modern tools and techniques indexing and query optimization.

CO4 – PO6: Moderately mapped as engineering knowledge is needed to apply indexing techniques and optimization of query in various sections of **society.**

CO5 – PO1: Moderately mapped as to apply concurrency control and recovery techniques engineering knowledge is needed.

CO5 – PO2: Strongly mapped as **analysis of complex problem** using concurrency and recovery techniques using engineering approach is needed.

CO5 –PO4: Moderately mapped as by analyzing system log and applying algorithms recovery of data is happened.

CO6 – PO1: Strongly mapped as applying emerging trends related to database management engineering knowledge is needed.

CO6 – PO6: Strongly mapped as applying engineering approach for use of emerging trends of database management system for **society** benefits is possible.

CO6 – PO7: Strongly mapped as use of emerging trends needed specifically for **societal problems and sustainable solutions**.