GEOSPATIAL DATABASE MANAGEMENT SYSTEM

ENGE 303

Lecture : 3 **Year : III**
Tutorial : 0 **Part : I**
Practical : 3

Course Objectives:
The objective of this course is to provide the principles, techniques, and tools of geospatial data management within database systems. It emphasizes database management systems, data models, ER models, spatial data models, spatial queries, spatial indexing, and computational geometry. By the end of the course, students will be able to design and implement spatial data models, perform spatial and non-spatial queries and joins, apply geospatial database techniques to real-world problems, and evaluate their role in decision-making processes.

1 Introduction (4 hours)

1.1 Database Management System (DBMS): Terms and terminologies; Application; Comparison with other data technologies
1.2 Geospatial database technology
1.3 Components and function of DBMS; Interaction with DBMS

2 Data Models and Database Languages (4 hours)

2.1 Overview of data models
2.2 Entity relationship (ER) model, relational model and unified modeling language (UML)
2.3 Database language: Types, constraints, keys and design issues
2.4 ER diagram

3 Relational Data Model (4 hours)

3.1 Terminologies and need of relational data model
3.2 Constraints and keys of relational database
3.3 Relational algebra and derived operations

4 Structured Query Language (SQL) (4 hours)

4.1 Background and basic structure
4.2 Set operation; Aggregate functions; Null values
4.3 Nested sub queries and views
4.4 Modification of database; Joined relationship
4.5 Data-definition language

5 Spatial Database Technology (6 hours)

5.1 Spatial DBMS (SDBMS)
5.2 Values of SDBMS
5.3 Basics of spatial taxonomy and data types (Vector and Raster)
5.4 Data mining

6 Spatial Concepts and Data Models (6 hours)

6.1 Spatial information models: Field and object based
6.2 Spatial data formats and exchange standards
6.3 Spatial operations: Set oriented; Topologies; Directional; Metric space; Euclidean
6.4 ER model with spatial notion
6.5 Object oriented data modeling with UML
6.6 Comparison of ER model and UML

7 Spatial Query Language (5 hours)

7.1 Concept on spatial query language
7.2 Spatial data standards
7.3 SQL for spatial databases; OGIS standard for extending SQL
7.4 Object-relational SQL; Object-relationship schema

8 Computational Geometry (6 hours)

8.1 Algorithms: Concept, analysis, optimality and data structure
8.2 Useful algorithm strategies
8.3 Polygon partitioning
8.4 Algorithm for spatial database

9 Spatial Storage and Optimization (6 hours)

9.1 Storage; Disks and files
9.2 Disk geometry and implication
9.3 Buffer manager
9.4 File structures
9.5 Clustering
9.6 Spatial indexing: R-tree; Quad-tree; Grid indexing
9.7 Storage optimization (Cost models)

Practical (45 hours)

1. Building ER model
2. Development of UML
3. Design schema for cadastral survey
4. Set operation; Aggregate functions; Null values in SQL
5. Nested sub queries and views in SQL
6. Modification of database; Joined relationship in SQL

7. Building a Postgres and PostGIS database
8. Working with PostGIS spatial functions
9. Spatial query exercise in Postgres and PostGIS
10. Using PostGIS in web application

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	4	6
2 and 3	8	10
4 and 7	9	12
5	6	8
6	6	8
8	6	8
9	6	8
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Shekhar, S., Chawla, S. (2003). Spatial databases (Latest Edition). Prentice Hall.
2. Rigaux, P., Scholl, M., Voisard, A. (Latest Edition). Spatial Databases: With Application to GIS. United Kingdom: Elsevier Science.
3. Ramakrishna, R., Gehrke, J. (2001). Database management systems (Latest Edition). McGraw-Hill Education.
4. Silberschatz, A., Korth, H. F., Sudarshan, S. (2011). Database System Concepts. United Kingdom: McGraw-Hill Education.
5. Li, D., Wang, S., Li, D. (2016). Spatial Data Mining: Theory and Application. Germany: Springer Berlin Heidelberg.
6. Yeung, A. K., Hall, G. B., Hall, G. B. (2007). Spatial Database Systems: Design, Implementation and Project Management (Latest Edition). Germany: Springer Netherlands.