**Program Name** : **Computer Engineering Program Group**

**Program Code** : **CO/CM/CW**

**Semester** : **Fifth**

**Course Title** : **Advanced Database Management Systems (Elective)**

**Course Code** : **22521**

## 1. RATIONALE

Advanced database management systems contain comprehensive contents on various concepts related to database systems, database design and management. Broadly it discusses about parallel and distributed database systems, database transactions, big data management and advances in database data. The student will get a detailed introduction about database administration and management, the role of machine learning in big data management. This course includes study of structured and unstructured database like MongoDB, SQL and XML for data management. The concept big data is used in today's information driven business world for managing big data. After learning this subject student will be able to use ADBMS as a backend for developing database.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply Advanced Database Management Systems concepts using MongoDB and XML**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Differentiate various database architectures.
b. Use Object Oriented and Advanced XML queries on Database.
c. Manipulate data using MongoDB commands.
d. Use Data Mining And Data Warehousing Concepts.
e. Use Big Data Concepts.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | | Practical | | | | | |
| L | T | P | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25# | 10 | 25 | 10 | 50 | 20 |

*(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.*

***Legends:*** ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment.*

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

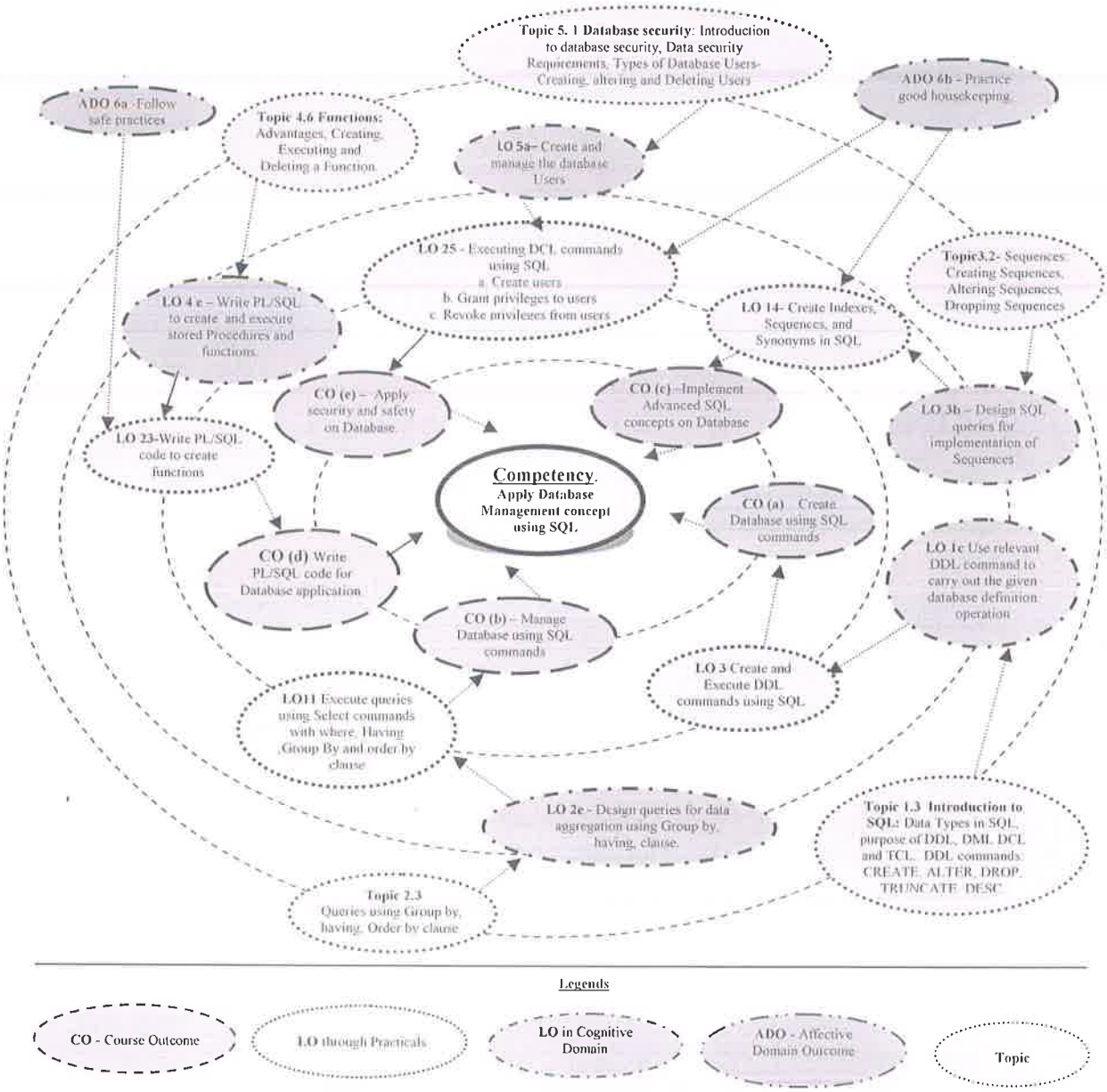


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| 1. | Implementing Locking protocols | I | 02 |
| 2. | Install and configure Database system (such as MySQL, MongoDB or any other relational database system) | III | 02 |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| 1. | Implementing Locking protocols | I | 02 |
| 3. | Create database using XML attributes and Elements. | II | 02 |
| 4. | Implement queries based on FLOWER expressions and joins using XQuery. | II | 02 |
| 5. | Implement queries based on Nested queries and sorting of results using XQuery. | II | 02 |
| 6. | Implement queries based on functions and types using XQuery. | II | 02 |
| 7. | Execute queries using structured type in SQL | II | 02 |
| 8. | Execute queries using type inheritance and table inheritance in SQL | II | 02 |
| 9. | Implement queries using Array and Multiset types in SQL | II | 02 |
| 10. | Execute queries using object identity and reference types in SQL | II | 02 |
| 11. | Design and Develop MongoDB Queries using basic operations | III | 02 |
| 12. | Implement aggregation Queries using MongoDB | III | 02 |
| 13. | Implement MongoDB Queries Usinf find() function | III | 02 |
| 14. | Implement aggregation Queries in MongoDB through MapReduce | III | 02 |
| 15. | Install and configure Any data mining tool (like WEKA) . | IV | 02 |
| 16. | Make use of installed data mining tool(like WEKA) | IV | 02 |
| | | **Total** | **32** |

***Note***

*i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

*ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| a. | Installation and configuration of database system | 10 |
| b. | Coding of queries and MongoDB programming | 40 |
| c. | Quality of result displayed by queries. | 30 |
| d. | Answer to sample questions | 10 |
| e. | Submit report in time | 10 |
| **Total** | | **100** |

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Work as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs

according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

## 17. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S. No. | Equipment Name with Broad Specifications | Exp. S. No. |
|---|---|---|
| 1.1 | Computer system<br>(Any computer system with basic configuration) | All |
| 1.2 | Any RDBMS software (MySQL/Oracle/SQL server/MongoDB or any other) | All |

## 18. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs)<br>(in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit – I Database Architecture** | 1a. Describe the given client-server Database Model.<br>1b. Use the given locking protocols for concurrency control.<br>1c. Apply parallel and distributed database techniques in given situation.<br>1d. Differentiate between Parallel and Distributed Databases. | 1.1 Introduction to client-server Database Model: Two-Tier Client server model, Three-Tier Client server model.<br>1.2 Concurrency Control Techniques: Concurrency control protocols: Locked Based protocols, granting of locks, Two Phase Locking protocol.<br>1.3 Introduction to parallel databases: Parallel database system architecture, Types of parallelism, Parallel Database Implementation.<br>1.4 Introduction to distributed databases: Distributed database system architecture, Benefits of distributed database system, Issues with distributed database systems. |
| **Unit II- Object Based Databases and XML** | 2a Create the given object based database using SQL<br>2b Write given SQL queries using Table Inheritance<br>2c Write given SQL queries using Array and Multiset.<br>2d Implement SQL queries to refer the given object using object identity.<br>2e Write XML queries on given data. | 2.1 Object Based Databases overview<br>2.2 Complex data types<br>2.3 Structured types and inheritance in SQL<br>2.4 Table inheritance<br>2.5 Array and multiset types in SQL<br>2.6 Object identity (OI) and reference types in SQL<br>2.7 XML: Introduction, structure of XML data, XML document schema ,Xpath, XQuery:FlOWER Expressions, Joins,Nested Queries, Sorting of functions, Functions and Types. |
| **Unit– II** | 3a. Differentiate structured and | 3.1 Structured versus Unstructured Data |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Advanced Database Techniques** | Unstructured Data.<br>3b. Use NoSQL database to solve given queries.<br>3c. Use MongoDB to solve given queries.<br>3d. Differentiate SQL and NoSQL databases.<br>3e. Write query to execute find() function on given data.<br>3f. Implement basic operations performed on MongoDB shell on given data.<br>3g. Write query using aggregate() method on given data. | 3.2 NoSQL database concepts: Types of NoSQL databases, NoSQL data modeling, Benefits of NoSQL, comparision between SQL and NoSQL database system.<br>3.3 NoSQL using MongoDB: Introduction to MongoDB Shell, Running the MongoDB shell, MongoDB client, Basic operations with MongoDB shell, Basic Data Types ,Arrays, Embedded Documents<br>3.4 Querying with MongoDB: find() function, specifying which keys to return, query criteria, OR queries, Types specific querying<br>3.5 Aggregation Introduction: Aggregation Pipeline, Aggregation using Map reduce, Single purpose aggregation |
| **Unit –IV Advances in Databases** | 4a. Define data mart, meta data<br>4b. Explain architecture of data warehouse<br>4c. Analyze given data using data mining.<br>4d. Describe the features of BI and BI components framework.<br>4e. Explain use of spatial databases in a given situation. | 4.1 Introduction to Data Warehouse :Characteristics, Types of Data Warehouse Architecture, Data Marts, Data Warehousing Lifecycle, Data Warehouse Development<br>4.2 Introduction to Data Mining Techniques: Data mining technology and its relation to data warehousing, Association rules, classification and clustering, Applications of data mining.<br>4.3 Introduction to business Intelligence: Features, frameworks, Types and approaches for machine learning<br>4.4 Introduction to Multimedia Databases, Mobile Databases and digital databases |
| **Unit-V Big Data Management** | 5.a Analyze the given situation for the use of Big data.<br>5.b Describe the given architecture of Hadoop.<br>5.c Explain given components of Hadoop.<br>5.d Explain use of cloudera in given situation.<br>5.e Explain given features of R-programming. | 5.1 Big Data<br>5.2 Introduction to Hadoop: Building Blocks and Components, Hadoop architecture, HBase, HIVE, Solid -State Drive<br>5.3 Cloudera, Oracle cloud,<br>5.4 Introduction to R-programming |

*__Note__: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Database Architecture | 08 | 04 | 04 | 04 | 12 |
| II | Object Based Databases and XML | 14 | 04 | 04 | 10 | 18 |
| III | Advanced Database Techniques | 12 | 06 | 04 | 06 | 16 |
| IV | Advances in Databases | 08 | 02 | 08 | 04 | 14 |
| V | Big Data Management | 06 | 02 | 04 | 04 | 10 |
| **Total** | | **48** | **18** | **24** | **28** | **70** |

***Legends:*** *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note****: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Undertake micro-projects.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.
i. Demonstrate students thoroughly before they start doing the practice.
j. Encourage students to refer different websites to have deeper understanding of the subject.

## 12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so

that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Develop and maintain XML database for Employee information System.
b. Design and develop MongoDB database for library management system.
c. Perform preprocessing of data using any data mining tool (like WEKA).
d. Install and configure Hadoop.
e. Perform database connectivity with any front end tool.

## 13. SUGGESTED LEARNING RESOURCES :

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Database Management Systems Application | Kogent Learning Solutions Inc. | Dreamtech Press 2014, ISBN-978-93-5119-476-7 |
| 2 | Database System Concepts | Korth Henery | Tata McGraw Hill Education, 6th Edition ,ISBN -13:978-93-329-0138-4 |
| 3 | Complete Reference: Mysql | Vaswani Vikram | McGraw Hill Education, ISBN-13: 9780070586840 |
| 4 | SQL, PL/SQL The Programming Language of ORACLE | Bayross Ivan | BPB Publications, 3rd Edition ISBN-13: 978-8176569644 |

## 14. SOFTWARE/LEARNING WEBSITES

a) https://www.tutorialspoint.com
b) https://www.w3schools.com
c) http://db.ucsd.edu/static/cse132b-sp01/oql.htm
d) https://docs.mongodb.com/manual/tutorial/install-mongodb-on-windows/
e) http://www.cs.stir.ac.uk/courses/CSC9T6/practicals/1%20Data%20Mining/1%20-%20Weka%201.pdf


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