Title (Units):	**COMP4035 Database System Implementation (3,3,0)**
Course Aims:	To give students an in-depth knowledge of relational database management systems (RDBMSs); to learn general RDBMS internals, including data storage, index structures, query evaluation and optimization, transaction management, concurrency control and crash recovery; and to discuss advanced topics such as database security, access control, distributed databases and data warehouses.
Prerequisite:	COMP2015 Data Structures and Algorithms COMP2016 Database Management

Course Intended Learning Outcomes (CILOs):
Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Explain underlying disk-based data storage, organization and access methods
2	Describe query evaluation and optimization, concurrency control, transaction management and recovery techniques
3	Identify advanced database technologies such as distributed databases and data warehouses
	Professional Skill
4	Analyze the tradeoffs of alternative implementation mechanisms
5	Implement some components of an RDBMS
	Attitude
6	Work as a team in project development

Calendar Description:	This course provides an in-depth knowledge of relational database management systems (RDBMSs). Topics include data storage, index structures, query evaluation and optimization, transaction management, concurrency control and crash recovery. In addition, advanced topics such as database security, access control, distributed databases and data warehouses will also be covered.

Teaching and Learning Activities (TLAs):

CILOs	Type of TLA
1-3	Students will learn the database system implementation techniques via lectures, tutorials, and assignments.
4	Students will investigate alternative database implementation mechanisms.
5-6	Students will work on a project to gain hands-on experience.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
1	Quizzes or Assignments	25%	1 - 5	Continuous assessments in the form of quizzes or assignments are designed to measure how well the students have learned the basic techniques in implementing a database system, including data storage, index structure, query evaluation and optimization, transaction management, crash recovery, etc.
2	Project	15%	1 - 6	A group project is designed to implement some components of an RDBMS.
3	Examination	60%	1 - 5	Final examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be analysis and skills based to assess the students' ability in implementation of database systems.

Assessment Rubrics:

Excellent (A)	• Achieve the first five CILOs, demonstrating a good mastery of both the theoretical and practical aspects of database system implementation • Have a thorough understanding of concepts and technologies involved in database system implementation, and be able to explain and highlight the key points of these concepts and technologies • Able to draw on a variety of relevant knowledge and concepts and appropriately apply them to analyze the tradeoffs of alternative implementation mechanisms with detailed explanations • Able to implement some components of a small relational database management system according to all requirements
Good (B)	• Achieve the first five CILOs, demonstrating a good understanding of both the theoretical and practical aspects of database system implementation • Have a good understanding of concepts and technologies involved in database system implementation • Able to make use of relevant knowledge and concepts and apply them to analyze the tradeoffs of typical implementation mechanisms with sound explanations • Able to implement some typical components of a small relational database management system according to most of the requirements
Satisfactory (C)	• Achieve most of the first five CILOs, demonstrating a basic level of understanding of the theoretical and practical aspects of database system implementation • Have a basic understanding of concepts and technologies involved in database system implementation • Able to make use of some relevant knowledge and concepts and apply them to analyze the tradeoffs of typical implementation mechanisms • Able to implement some typical components of a small relational database management system according to some of the requirements
Marginal Pass (D)	• Achieve most of the first five CILOs, with a minimal level of understanding of the theoretical and practical aspects of database system implementation • Have a minimal level of understanding of concepts and technologies involved in database system implementation • Demonstrate the ability to apply some relevant knowledge and concepts to analyze the tradeoffs of a limited number of implementation mechanisms • Able to implement at least one typical component of a small relational database management system according to some minimal requirements
Fail (F)	• Achieve less than three of the CILOs, and have little understanding of the theoretical and practical aspects of database system implementation • Unable to provide solutions to simple problems which require basic understanding of concepts and technologies involved in database system implementation • Unable to analyze the tradeoffs of alternative implementation mechanisms • Have little understanding of database implementation technologies and have difficulty in implementing any component of a small relational database management system

Course Content and CILOs Mapping:

Content		CILO No.
I	Storage and File Structures	1, 4, 5, 6
II	Indexing and Hashing	1, 4, 5, 6
III	Query Evaluation and Optimization	2, 4, 5, 6
IV	Transaction Management and Concurrency Control	2, 4
V	Crash Recovery	2, 4
VI	Advanced Topics	3

References:

- Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill, 2003.
  6th Edition, McGraw Hill, 2011.
- Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, Addison Wesley, 2015.
- Hector Garcia-Molina. Database Systems: The Complete Book, 2nd Edition, Prentice Hall, 2014.
- Carlos Coronel and Steven Morris. Database Systems: Design, Implementation, & Management, 12th Edition, Course Technology, 2016.
- Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts,

Course Content:

Topic

I.   Storage and File Structures
       A. Physical storage media
       B. Disk space management
       C. File organization
       D. Organization of pages and records in files
       E. Buffer management

II.   Indexing and Hashing
       A. Indexed sequential access method
       B. Dynamic tree-structured indexing
       C. Static hashing
       D. Dynamic hashing

III.   Query Evaluation and Optimization
       A. The system catalog
       B. Query execution plan
       C. Evaluating query operators
       D. Query optimization
       E. External sorting

IV.   Transaction Management and Concurrency Control
       A. The ACID properties
       B. Schedule, serializibility, and recoverability
       C. Concurrency control protocols

V.   Crash Recovery
       A. Type of failures
       B. The log and other recover-related structures
       C. Checkpointing
       D. Recovery techniques

VI.   Advanced Topics