COURSE SYLLABUS

I. General Information		
1. Course Information		
a.	Faculty:	INFORMATION TECHNOLOGY
b.	Department:	All
c.	Course Code:	INSY 8222
d.	Course Name:	Database Management Systems
e.	Number of credits:	3
f.	Prerequisite:	None
g.	Academic Year	2024/2025
h.	Semester:	2
i.	Time:	1pm – 4pm
j.	Venue:	AUCA Gishushu Campus, Room G109
k.	Technical Support:	IT Technician Mr. Emmanuel Ndacyayisenga
2. Instructors Information		
a.	Name:	TURIHO Jean Claude, Masters
b.	Contact :	Email: jeanclaude.turiho@auca.ac.rw Phone: +250782416071
c.	Consultation Time:	Monday 2:00pm – 5:00pm Friday: 8:00am – 12:00pm
d.	Location:	Faculty of Information Technology
II. Course Description		

This course provides an introduction to the principles and practices of database management systems. Students will learn the fundamental concepts of database design, implementation. The course covers a range of topics, including data relational model, Entity-Relationship (ER) model, query languages (SQL), and database design (functional dependency, normalization).

Through hands-on projects, students will gain experience in designing databases, writing SQL queries using ORACLE dbms, and managing data integrity.

III. Learning Outcomes	

a	**3. 1. Knowledge and understanding**
	
	 Having successfully completed the module, students should be able to demonstrate knowledge and understanding of:
	
	    i. have a broad understanding of database concepts and database management system software
	   ii. have a high-level understanding of major DBMS components and their function
	  iii. be able to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.
	  iv. be able to write SQL commands to create tables, insert/update/delete data, and query data in a relational DBMS.

b	**3. 2. Cognitive/Intellectual Skills/Application of Knowledge**

	Having successfully completed the module, students should be able to: i. Apply critical thinking to analyze complex data requirements and develop appropriate database solutions ii. Use abstraction techniques such as Entity-Relationship (ER) modeling or data relational model to represent complex real-world entities and relationships. iii. Formulate SQL queries to manipulate and retrieve data from relational databases. iv. Implement concepts of transaction management (such as ACID properties) to ensure data integrity and reliability in multi-user environments.
c	**3. 3. Communication/ICT/Numeracy/Analytic Techniques/Practical Skills** ***Communication Skills*** i. Explain database concepts clearly using appropriate technical language, both in writing and orally. ii. Document database designs and solutions through well-organized reports that detail data models, design choices, and implementation strategies. iii. Present database project findings and system solutions to both technical and non-technical audiences, using clear and concise language. iv. Collaborate effectively in teams to design, implement, and troubleshoot database solutions, fostering clear communication among team members. ***ICT (Information and Communication Technology) Skills*** v. Use Oracle DBMS tool to design, create, and manage databases. vi. Leverage Integrated Development Environments (IDEs) and SQL query editors for writing and executing database queries efficiently. ***Numeracy Skills*** vii. Apply mathematical and logical reasoning to optimize database queries and data structures. viii. Perform data aggregation and statistical operations (e.g., SUM, AVG, COUNT) using SQL for business analytics and reporting. ***Analytic Techniques*** ix. Analyze data requirements and translate them into database structures that meet business objectives. x. Use normalization and data integrity rules to analyze and refine database designs, eliminating redundancy and ensuring consistency. xi. Interpret query results and explain patterns or trends in data to derive actionable insights. xii. Perform root-cause analysis to identify and fix performance issues or database errors, using profiling tools or query logs.

	Practical Skills
	xiii. Design and implement databases from scratch using real-world data sets, ensuring correct structure, constraints, and optimization.
	xiv. Create and manage databases using tools and technologies SQL in practical, hands-on projects.
	xv. Write efficient SQL queries to retrieve, manipulate, and analyze data across multiple tables using joins, subqueries, and set operations.
	xvi. Implement backup, restore, and recovery strategies to safeguard data and ensure business continuity in case of failures.

d	**3. 4. General Transferable Skills**
	
	A. Personal intellectual and Professional Autonomy
	Having successfully completed the module, students should be able to:
	
	  i. Describe the components of a database system and give examples of their use.
	  ii. Identify major DBMS functions and describe their role in a database system.
	  iii. Explain the concept of data independence and its importance in a database system
	
	B. Employability and Career Development
	
	Having successfully completed the module; students should be able to:
	  I. To work as Database designer, administrator.
	  II. Help the government to create a job that can employee the population.
	  III. To elaborate and present a business plan of his/her own choice; plan, design and implement a database project.
	C. Global Citizenship
	Having successfully completed the module; students should be able to:
	  i. Analyze the situation of the database projects prevailing in the country;
	  ii. Advise the entrepreneurs and those who want to manage their business using database
	  iii. Conduct studies that promote a successful database implementation.
	D. Lifelong Learning
	Having successfully completed the module, students should be able to:
	  i. Develop the attitude and the philosophy of job creation;
	  ii. Set goals and purposes pertaining to database use in business company.
	E. Collaboration, Team Work and Leadership
	Having successfully completed the module, students should be able to:
	  i. Develop the spirit of interpersonal, scientific problem-solving methods, and communication skills needed for a group work towards a common goal using the knowledge and skills gained in this module.
	F. Research, Creativity, Innovation, Scholarship and Enquiry
	Having successfully completed the module, students should be able to:

    i.   Present the most fundamental elements of database ethics;

    ii.   Apply various expertise and skills in database management;

G. Ethical, Social and Professional Understanding

Having successfully completed the module, students should be able to:

    i.   Display professional behavior in the science analysis, practices, and communication;

    ii.   Inspire professional ethical awareness in decision making related to database management.

H. Financial Literacy

Having successfully completed the module, students should be able to:

    i.   Advise the businessmen using knowledge acquired;

    ii.   Carry out consultancies to solve database management problems within the projects.

IV. Indicative Content

Chapter 1: Databases and Database Users

Week	Date	Objectives	Content	Learning Activities
1	Jun, 16/-20/2025	- Understand the basic concepts of databases and database systems. - Identify the different types of database users. - Explain the importance of databases in modern applications.	- Definition and purpose of databases. - Characteristics of database systems (self-describing nature, insulation, data abstraction). - Roles of different database users (end users, database administrators, application programmers). - Introduction to the database management system (DBMS) and its components.	a. Lecture: Overview of databases and DBMS. b. Group discussion: Identify and discuss examples of databases in real-world applications. c. Short quiz: Basic terms and concepts of databases. d. Homework: Read an introductory chapter on database systems and list five database examples from daily life.

Chapter 2: Database System Concepts and Architecture

Week	Date	Objectives	Content	Learning Activities

2	Jun, 16/-20/2025	- Understand the fundamental concepts of database systems.
		- Explore the three-schema architecture and data independence.
		- Learn about database management system components and architecture.
			- Definitions
			  1. Definition of a database and DBMS.
			  2. Advantages of using a DBMS over file systems.
			  3. Key characteristics of databases
			- Three-schema architecture:
			  1. Internal, conceptual, and external levels.
			  2. Data independence: logical and physical.
			- Client-server and
				a. Read chapters on database system architecture from the recommended textbook or lecture slides.
				b. Watch a video lecture or tutorial on three-schema architecture and data independence.
				c. Participate in a group discussion on the pros and cons of

			distributed database architectures. - Centralized vs. decentralized database systems.	centralized vs. distributed databases. d. Complete a quiz or short assignment on database system components and architectures. e. Design a simple schema illustrating the three-schema architecture for a sample database scenario.
Chapter 3: Data Modeling Using the Entity– Relationship (ER) Model				
3	Jun, 23/-27/2025	- Understand the principles of data modeling and the purpose of the Entity–Relationship (ER) model. - Identify and define entities, attributes, and relationships. - Construct ER diagrams to represent real-world scenarios.	- Introduction to Data Modeling (Importance and purpose of data modeling in DBMS, and Levels of abstraction: conceptual, logical, and physical) - The Entity–Relationship Model (Key components: entities, attributes, and relationships; Entity types: strong and weak entities; Attributes: simple, composite, derived, and multivalued) - Relationships in ER Models (Relationship types and their cardinality; Roles in relationships; Degree of relationships (unary, binary, ternary)) - ER Diagram Notations - Case Study: Creating an ER Diagram	f. Lecture and Discussion: Introduction to ER modeling principles and use cases. g. Hands-On Exercise: Create an ER diagram for a given business scenario (university enrollment system). h. Group Activity: Collaborative design of an ER model for a library management system. i. Quiz: Identify errors or improvements in sample ER diagrams. j. Homework: Develop an ER diagram for a small e-commerce platform, focusing on customers, products, and orders. k. Online Forum Discussion: Share ER diagrams and critique peers' models for clarity and completeness.
Chapter 4: The Enhanced Entity–Relationship (EER) Model				
Week	**Date**	**Objectives**	**Content**	**Learning Activities**
4	Jun, 23/-27/2025	- Understand the concepts of the	- Overview of the Enhanced Entity–Relationship Model	a. Reading and Videos: Read chapters on EER

		Enhanced Entity–Relationship (EER) model. - Learn about specialization, generalization, and inheritance. - Explore how to represent complex relationships using the EER model. - Understand the role of constraints and design considerations in EER modeling.	(Extension of the basic ER model; Key differences between ER and EER) - Specialization and Generalization (Definitions and use cases; Representing hierarchies and inheritance in EER diagrams) - Aggregation and Composition (Concepts and notations; Practical applications in complex systems) - Constraints in EER Modeling (Participation constraints; Disjointness and completeness constraints)	models from the recommended textbook. Watch instructional videos on EER diagrams and their applications. b. Interactive Exercises: Design EER diagrams for given scenarios involving specialization and generalization. Analyze sample EER diagrams to identify constraints and relationships. c. Practice Problems: Map EER diagrams to relational schemas. Solve quizzes focused on EER concepts and constraints. d. Group Activity: Collaborate on a case study to model a real-world scenario using the EER model. e. Discussion Forum: Participate in discussions about the advantages and challenges of using EER models in database design.
Chapter 5: The Relational Data Model and Relational Database Constraints				
5	Jun, 30/- Jul 04/2025	- Understand the fundamental concepts of the relational data model. - Identify key relational database constraints (e.g., primary keys, foreign keys, domain constraints). - Apply relational constraints in database design and	- Basic structure of relational databases (relations, tuples, attributes). - Definition and distinction between schema and instance and examples of relational schemas - Relational Database Constraints: Domain constraints; key constraints (primary key, candidate key, unique	a. Lecture and Discussion: Attend a lecture introducing the relational model and constraints and participate in discussions and Q&A to clarify doubts. b. Hands-on Exercises: Write SQL scripts to define and enforce constraints and Solve practice

		implementation.	constraints); Referential integrity constraints (foreign keys).; General constraints (assertions and checks). - Tools and Techniques: Using SQL to define constraints; Database design considerations.	problems on relational schemas and constraints. c. Group Activity: Analyze a sample relational database for constraint violations. d. Self-Study: Read relevant chapters from the recommended textbook and Watch supplementary videos on relational database design. e. Assessment: Complete a short quiz on relational database constraints and submit a mini-project defining a relational schema and constraints for a sample application.
Chapter 6: Basics of Functional Dependencies and Normalization for Relational Databases				
6	Jun, 30/- Jul 04/2025	- Understand the concept of functional dependencies and their significance in database design. - Learn how to identify and define functional dependencies in a relational schema. - Explore the purpose and processes of normalization in relational databases. - Apply normalization techniques to transform schemas into higher normal forms.	- Introduction to Functional Dependencies: Definition and examples of functional dependencies; Importance in relational schema design; and Determinants and dependent attributes. - Anomalies in Relational Databases: Insertion, update, and deletion anomalies and Impact of unnormalized data on database consistency. - Normalization Process (Objectives of normalization: minimizing redundancy and ensuring data integrity and steps in normalization: First Normal Form (1NF): Elimination of repeating	a. Interactive Tutorials: Video lectures on functional dependencies and normalization and step-by-step walkthrough of normalization processes. b. Hands-On Exercises: Identifying functional dependencies in sample schemas and normalizing schemas to achieve 1NF, 2NF, 3NF, and BCNF. c. Quizzes and Assessments: Multiple-choice

			groups; second Normal Form (2NF): Addressing partial dependencies; Third Normal Form (3NF): Eliminating transitive dependencies; and Boyce-Codd Normal Form (BCNF): Addressing additional constraints.) - Case Studies and Examples (Examples of transforming a schema through different normal forms; pitfalls and best practices in normalization)	quizzes to test understanding of key concepts and problem-solving assignments focusing on normalization techniques. d. Discussion Forums: Participate in peer discussions on the challenges and benefits of normalization; Share insights and solutions to practice exercises. e. Additional Resources: Reading materials on advanced normalization concepts and links to academic papers and industry examples.
7	Jul, 07/-11/2025	- MID TERM EXAMS		
- Chapter 7: The Relational Algebra and Relational Calculus				
8	Jul, 07/-11/2025	- Understand the theoretical foundation of relational databases through relational algebra and relational calculus. - Learn the operators and operations used in relational algebra.	- Introduction to Relational Algebra: Basic concepts and operators (Selection, Projection, Union, Intersection, Difference, Cartesian Product). Additional operators: Join, Division, Rename. Use of relational algebra in query optimization.	a. Lectures. b. Workshops/Hands-On Sessions c. Case Studies. d. Quizzes/Assignments. e. Discussion Forum: Discuss real-world applications of relational algebra and calculus in database systems.
9	Jul, 07/-11/2025	- Differentiate between procedural and non-procedural query languages. - Apply relational calculus to express	- Relational Calculus: Tuple relational calculus (TRC) – syntax and semantics. Domain relational calculus (DRC) – syntax and semantics. Comparison	f. Lectures. g. Workshops/Hands-On Sessions h. Case Studies. i. Quizzes/Assignments.

		database queries logically.	between TRC and DRC.	j. Discussion Forum: Discuss real-world applications of relational algebra and calculus in database systems.
10	Jul, 14/-18/2025		- Applications and Use Cases: Writing queries using relational algebra. Translating relational calculus expressions into SQL queries.	a) Lectures. b) Workshops/Hands-On Sessions c) Case Studies. d) Quizzes/Assignments. e) Discussion Forum: Discuss real-world applications of relational algebra and calculus in database systems.
Chapter 8: Basic SQL				
11	Jul, 14/-18/2025	- Understand the basic structure of SQL queries. - Learn how to retrieve data using SELECT statements.	- Introduction to SQL and its role in DBMS. - Writing basic SELECT statements. - Filtering data with the WHERE clause.	a) Video Lecture b) **Hands-on Practice**: Write and execute simple SQL queries using a sample database, apply filters using the WHERE clause, Use aggregate functions to analyze data, Group and summarize data, and c) **Discussion Forum**: Participate in a thread discussing the importance of SQL in data management and share examples of queries you've created.
12	Jul, 21/-25/2025	- Perform filtering and sorting using WHERE and ORDER BY clauses.	- Sorting results using ORDER BY. - Using aggregate functions for data analysis.	a) Video Lecture b) **Hands-on Practice**: Write and execute simple SQL queries using a sample database, Apply filters using the WHERE clause, Use

				aggregate functions to analyze data, Group and summarize data, and
				c) **Discussion Forum**: Participate in a thread discussing the importance of SQL in data management and share examples of queries you've created.
13	Jul, 21/-25/2025	- Apply aggregate functions like COUNT, SUM, AVG, MIN, and MAX. - Group data using GROUP BY and filter grouped data using HAVING.	- Grouping and summarizing data using GROUP BY and HAVING. - Practical examples and common use cases.	a) Video Lecture b) **Hands-on Practice**: Write and execute simple SQL queries using a sample database, Apply filters using the WHERE clause, Use aggregate functions to analyze data, Group and summarize data, and c) **Discussion Forum**: Participate in a thread discussing the importance of SQL in data management and share examples of queries you've created.
14	Jul, 28/-Aug, 1/2025	Revision week		
15	**Aug 3rd – 8th 2025**	Final Exam Period		

V. Methodological Strategies	
1. Cognitive	
a.	Introduction and Connection to Prior Knowledge
b.	Problem-Based Learning
c.	Conceptual Framework Building
d	Iterative and Scaffolded Practice
e	Active Engagement
f	Reflective Thinking
g	Integration and Real-World Applications
h	Assessment and Feedback

2. Application	
a.	Objective-Oriented Approach
b.	Blended Learning
c	Problem-Based Learning
d	Collaborative Projects
e	Iterative Learning and Feedback
f	Industry-Relevant Practices
g	Tools and Techniques Integration
h	Evaluation
3. Integration of faith and learning	
a.	Starting each class with a devotional
b.	Connecting each chapter to the Holy Scripture
c.	The content will be discussed with the support from the Bible

VI. Students Requirements

1. Introduction of Class and University Policies

Participation is encouraged.
Attendance is mandatory.
No gum chewing
Late coming of 15 minutes results in being prevented from class attendance.
Cheating and plagiarism result in disciplinary action.
Use of phones in the class, unless instructed by the lecturer for learning purposes, and exam is prohibited.
Class sitting setting is compulsory.
Moving chairs without authorization is prohibited.
Wearing necklaces and earrings is prohibited.

2. Class Management

a.	Attendance:	Campus policy on attendance will be applied. In order to receive credit for this course, prompt attendance is required for all class sessions. No more than 25% of classes can be missed. Exceptions to this stipulation may be provided by the instructor only in cases of dire emergency. Points will be given for face-to-face class attendance as follows: 2 points when on time; 1 if late; 0 if absent. You also have opportunities to participate in various class activities. Yet another avenue for participation is through sharing in the course LMS. You are encouraged to communicate with each other regarding course issues and to also share valuable articles, videos, and blogs. Your class participation will be assessed by taking into consideration all of these aspects.
b.	Discipline:	Students are expected to attend class as scheduled, be on time and remain for the entire class session. Failing to show for class, being late and leaving early are unacceptable educational and administrator practices. Additionally, it is highly important that you network with other students and being in class facilitates this communication. If you are going to be late or cannot attend class, you are expected to notify the instructor in advance either by email or phone. Failure to do so will result in an unexcused absence.
		Free discussion, inquiry and expression are encouraged in this class.

		Classroom behavior that interferes with either (a) the instructor's ability to conduct the class or (b) the ability of students to benefit from the instruction is not acceptable. Come on time & leave when class is finished! Turn cellular phones or other electronic devices before entering the classroom! If your job requires the use of electronic devices, obtain prior permission from instructor, talking while others are speaking is not acceptable, wait your turn!
c.	Code of Conduct:	Students are expected to maintain the highest standards of academic integrity. Behavior that violates these standards is not acceptable. Examples are the use of unauthorized material, communication with fellow students during an examination, attempting to benefit from the work of another student and similar behavior that defeats the intent of an examination or other class work. Cheating on examinations, plagiarism, and improper acknowledgment of sources in essays are considered very serious offenses and shall be grounds for disciplinary action as outlined in the student policy. Persons involved in academic dishonesty will be disciplined in accordance with the established AUCA policies and procedures, which include loss of marks, failing grades, and suspension or expulsion.
d.	Financial Clearance:	Attendance to this class requires student to clear with finance office.

VII. Inclusive Education

Depending of the disability of the student found in the classroom, the class monitor will be obliged to see how to help the student with disability.

VIII. Assessment Strategies

Assignment, Quizzes, Participation, Projects:	30%
Mid Semester:	30%
Final Exam:	40%
Total	100%

IX. Strategy for Feedback and Student Support

In class comments, observations and comments in the Moodle shall be given during the presentations of assignments while feedback on two exams which shall be marked accordingly will be returned to the students.

The feedback on formative assessments provided in time help the students to recognize their strengths and errors, for improvement of their performances.

X. References

1. Text Books

1. Elmasri, R., & Navathe, S. B. (2016). *Fundamentals of database systems* (7th ed.). Pearson Education.

2. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2019). *Database system concepts* (7th ed.). McGraw-Hill Education.

3. Connolly, T., & Begg, C. (2014). *Database systems: A practical approach to design, implementation, and*

management (6th ed.). Pearson Education.

2. Journals
1. Özsu, M. T., & Valduriez, P. (2020). *Principles of distributed database systems* (4th ed.). Springer.
2. Stonebraker, M., & Hellerstein, J. M. (2005). What goes around comes around. *Readings in Database Systems*, 5, 2–20.
3. Codd, E. F. (1970). A relational model of data for large shared data banks. *Communications of the ACM*, 13(6), 377–387. https://doi.org/10.1145/362384.362685
4. IBM. (n.d.). What is a database management system (DBMS)? Retrieved January 13, 2025, from https://www.ibm.com/topics/dbms
3. Online Resources
1. W3Schools. (n.d.). SQL tutorial. Retrieved January 13, 2025, from https://www.w3schools.com/sql/
2. GeeksforGeeks. (n.d.). Database management system (DBMS) tutorials. Retrieved January 13, 2025, from https://www.geeksforgeeks.org/dbms/
3. Oracle. (n.d.). Oracle database documentation. Retrieved January 13, 2025, from https://docs.oracle.com/en/database/
4. Microsoft. (n.d.). SQL Server documentation. Retrieved January 13, 2025, from https://learn.microsoft.com/en-us/sql/

XI. Module team

Mr. TURIHO Jean Claude   Module Leader
Mr.   Member

XII. Unit approval

Deans and Heads of all Departments contributing to the program to confirm agreement

FACULTY	HOD/DEAN
Information Technology	Signature: Print Name: **Assoc, Prof. Dr. Sebajenzi Jason** Dean, Faculty of Information Tchnology
	Signature: Print Name: Mr. MANIRAHO Laurent **HOD, Department of Information Management Systems**

Seen and Agreed

Library	Signature
	Print Name: Niyomwungeri Robert (Director)
ICT	Signature
	Print Name: Assoc, Prof. Dr. Sebajenzi Jason (Director)
Quality office	Signature
	Print Name: Dr. Cyeze Emmanuel (Director)