

Institute/ School Name	Chitkara School of Engineering and Technology		
Department Name	Department of Computer Science & Engineering		
Program Name	Bachelor of Engineering (B.E.) Computer Science & Engineering		
Course Code	CS116	Course Name	Database Management System
L-T-P (Per Week)	3-0-2	Course Credits	04
Academic Year	2023-24	Semester/Batch	3 <sup>rd</sup> /2022
Course Coordinator	Dr. Praveen Kantha		

## 1. Course Outline:

Introduction, Schemas, Architecture for DBMS, ER Model, Keys and their types, Relational Algebra, Normalization, Functional Dependencies, Introduction to Database Security, Transaction processing Concepts, ACID Properties, Schedules, Serializability, Concurrency Control, Locking, Modes of Locking, Multiple Granularity.

## 2. Programme Outcomes (POs):

At the end of the programme, students will be able to:	
PO 1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PO 3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	<b>Individual and teamwork:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	<b>Life-long learning:</b> Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### 3. Course Learning Outcomes (CLO):

Student should be able to

**CLO1:** To realize the necessity of an integrated database development and its related concepts with regard to the development of application software.

**CLO2:** To understand the various data modelling techniques and their pros and cons during the incidence of database operations.

**CLO3:** To elicit the process of formalization of data using different normalization forms.

**CLO4:** To become proficient at performing data definition, data manipulation, transaction control operations.

**CLO 05:** To understand and achieve data security with the application of integrity constraints and various other techniques for performing secure database transactions.

### 4. CLO-PO Mapping Matrix:

Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CLO1	H	H	H		M		L					
CLO2	H	H	H	M								
CLO3			H				L					M
CLO4		H	H						M			
CLO5		H	H						M		H	M

### 5. ERISE Grid Mapping:

Feature Enablement	Level(1-5, 5 being highest)
Entrepreneurship	1
Research/Innovation	1
Skills	5
Employability	4

### Recommended Books (Reference Books/Text Books):

**B01:** Elmasri, R., & Navathe, S. B. (2006). Database systems: models, languages, design, and application programming. Pearson Education India.

**B02:** Dubey, A. K. (2011). Database Management Concepts. S.K. Kataria & Sons.

**B03:** Miller, L. (2011). Oracle Autonomous Database for Dummies. Oracle Cloud.

**B04:** Loney, K. (2004). Oracle database 10g: the complete reference. London: McGraw-Hill/Osborne.

**B05:** Silberschatz, A., Korth, H. F., & Sudarshan, S. (2011). Database system concepts. McGraw-Hill.

### 6. Other readings and relevant websites:

	Link of Journals, Magazines, Websites and Research Papers
<b>R1</b>	<a href="https://onlinecourses.nptel.ac.in/noc23_cs79/preview">https://onlinecourses.nptel.ac.in/noc23_cs79/preview</a>
<b>R2</b>	<a href="https://www.c-sharpcorner.com/article/what-are-object-oriented-databases-and-their-advantages2/">https://www.c-sharpcorner.com/article/what-are-object-oriented-databases-and-their-advantages2/</a>
<b>R3</b>	<a href="https://nptel.ac.in/courses/106106220">https://nptel.ac.in/courses/106106220</a>
<b>R4</b>	<a href="https://cse.iitkgp.ac.in/~pabitra/course/dbms/dbms_new.html">https://cse.iitkgp.ac.in/~pabitra/course/dbms/dbms_new.html</a>

	Link of Audio-Video resources
V1	<a href="https://tinyurl.com/IITDBMS">https://tinyurl.com/IITDBMS</a>
V2	<a href="https://www.youtube.com/@databasemanagementsystem-i4463">https://www.youtube.com/@databasemanagementsystem-i4463</a>
V3	<a href="https://nptel.ac.in/courses/106104135">https://nptel.ac.in/courses/106104135</a>

\* Resources uploaded on the ERP system is accessible to all the students registered for the course.

## 7. Recommended Tools and Platforms:

- Code Quotient (online platform- <https://codequotient.com/>)

## 8. Course Plan:

Lecture Number	Topics	Weightage in ETE (%)	Instructional Resources
1-4	Introduction to database, Characteristics of database approach, Advantages and Disadvantages of DBMS approach	30	B01, R1, V1
5-7	Introduction to data models, Introduction to ER model, Introduction to Relational Model		B01, B02, R2, V2
8-9	Design and draw an ER diagram. Refer Annexure-1		
10-11	Schemas, Instances, Schema architecture, Data Independence and its types, Architecture for DBMS- One Tier, Two-Tier, Three Tier Architecture		B02, V2
12-13	Write SQL queries for Employee Database Schema. Refer Annexure-1		
14-15	Write SQL queries for Library Database schema. Refer Annexure-1		
16-19	ER Model: Database design process, Entity Types, Entity sets, Attributes, Strong and Weak entity, Keys and their types, Integrity Constraints, ER diagrams, E.F Codd Rules.		B01, R3
20-21	Write SQL queries for Sales Database schema. Refer Annexure-1		
22-23	Write SQL queries for Student Database schema. Refer Annexure-1		
24-26	Introduction to Relational Algebra: Unary operation, Relational Algebra Operations from Set Theory, Binary Relational Operations (Join, Division)	40	B01, B03, V2
27-28	Write SQL queries for Flight Database schema. Refer Annexure-1		
29-30	Write SQL queries for Order Database schema. Refer Annexure-1		
31-33	Introduction to Normalization, Functional Dependencies (Trivial and non-trivial), Types of Functional Dependencies(Full, Partial).		B01, B02, R2, V2
34-39	Types of Functional Dependencies (Transitive, Multi-valued & Join Dependencies), 1stNormal Form and anomalies, Inference rules and questions on proving them, Closure of attribute set and closure of functional dependency set, Covers and equivalence, non-redundant cover, canonical cover, Find candidate key, prime and non-prime attributes, Decomposition and its desirable properties, 2 <sup>nd</sup> Normal Form and conversion.		B01, B02, B05, R2, V2
40-41	Write SQL queries for Movie Database schema. Refer Annexure-1		
42-43	Write SQL queries for Employee Database schema. Refer Annexure-1		
44-49	3 <sup>rd</sup> Normal Form and conversion, Boyce Codd Normal Form and conversion, 4thNormal Form (what is the highest normal form),		B01, B02, B05, R2, V2

	5th Normal Form database, Introduction to transaction processing Concepts (transaction system, transaction operations), ACID Properties (transaction state, types of failures), Introduction to Schedules		
50-51	Write SQL queries for Employee Database schema. Refer Annexure-1		
52-53	Write SQL queries for Teacher Database schema. Refer Annexure-1		
54-59	Types of Schedules (Serial and Non-Serial Schedule), Introduction to Serializability (testing), Introduction to Conflict and View Serializability (numericals), Introduction to Recoverability, Checkpoints (recovery from transaction failure), Cascade less schedule, log-based recovery, Deferred database modification, immediate database modification, Introduction to Concurrency, Problems in concurrency techniques, Introduction to Concurrency techniques, Locking, Modes of Locking (shared lock and exclusive lock), Two-phase locking protocol (growing and shrinking phase), Protocols (static, dynamic and strict)	30	B01, B02, BO5, R2, V2
60-61	Write SQL queries for Client_master Database schema. Refer Annexure-1		
62-64	Concurrency Control based on Timestamp Ordering Protocol, Multiple Granularity.		B01, B02, BO5, R2, V2

## 9. Industry Interventions:

- Industry Curated Module:
  - a. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01275806667282022456\\_share/d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_share/d/overview)
  - b. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0127673005629194241\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0127673005629194241_shared/overview)

## 10. Action plan for different types of learners

Slow Learners	Average Learners	Advanced Learners
Remedial Classes	Workshops/ Practice Assignment	Coding/Interclass Competition

## 11. Evaluation Scheme & Components:

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
Internal Component 1	Formative Assessments (FAs)	02*	20%	Viva / Written Test
Internal Component 2	Sessional Tests (STs)	03**	30%	Written Test
External Component	End Term Examination (ETEs)	01	50%	Written Test
<b>Total</b>		<b>100%</b>		

\* There will be 02 FAs, both are mandatory, and the ERP system automatically picks the average of both for the calculation of final marks.

\*\* Out of 03 STs, the ERP system automatically picks the best 02 ST marks to evaluate final marks.

## 12. Details of Evaluation Components:

Evaluation Component	Description	Syllabus Covered (%)	Timeline of Examination	Weightage (%)
Internal Component 1	FA1	Up to 25%	Week 4	20%
	FA2	26%-50%	Week 9	
Internal Component 2	ST 01	Upto 40% (Lectures 1-24)	Week 6	30%
	ST 02	40% - 80% (Lectures 25-50)	Week 12	
	ST 03	100% (Lectures 1-64)	Week 16	
External Component	End Term Examination*	100%		50%
<b>Total</b>				100%

\* Minimum 75% attendance is required to become eligible for appearing in the End Semester Examination

## 13. Format of Evaluation Components:

Type of Assessment	Total Marks	1 Mark MCQ	2 Marks	5 Marks	10 Marks
*Formative Assessment	20	10	-	-	-
Sessional Tests	40	5	5	3	1
End Term Examination	60	10	5	4	2

\*Formative assessment will carry weightage of 5 marks Infosys infyspringboard certification, 5 marks code quotient module completion and 10 marks MCQ.

## 14. This Document is approved by:

Designation	Name	Signature
Course Coordinator	Dr. Praveen Kantha	
Program Incharge/HoD	Dr. Hakam Singh	
Pro VC	Dr. Meenu Khurana	
Date		

\*Incase of revision in earlier document:

Date of Creation of earlier document		Percentage of Revision	
--------------------------------------	--	------------------------	--

## Annexure-1

S.No	Experiment
1.	<p>Design and draw an ER diagram.</p> <p>Consider the following information about a university database:</p> <ul style="list-style-type: none"> <li>a) Professors have an SSN, a name, an age, a rank, and a research speciality.</li> <li>b) Projects have a project number, a sponsor name (e.g., NSF), a starting date, an ending date, and a budget.</li> <li>c) Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D.).</li> <li>d) Each project is managed by one professor (known as the project's principal investigator).</li> <li>e) Each project is worked on by one or more professors (known as the project's co-investigators).</li> <li>f) Professors can manage and/or work on multiple projects.</li> <li>g) Each project is worked on by one or more graduate students (known as the project's research assistants).</li> <li>h) When graduate students work on a project, a professor must supervise their work on the project. Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one.</li> <li>i) Departments have a department number, a department name, and a main office.</li> <li>j) Departments have a professor (known as the chairman) who runs the department.</li> <li>k) Professor work in one or more departments, and for each department they work in, a time percentage is associated with their job.</li> <li>l) Graduate students have one major department in which they are working on their degree.</li> <li>m) Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take.</li> </ul> <p>Use only the basic ER model here: entities, relationships, and attributes. Be sure to indicate any key and participation constraints.</p>
2.	<p>Write SQL queries for Employee Database Schema.</p> <p>Consider the Employee Database, where the primary keys are underlined.</p> <p>EMPLOYEE (<u>employee-name</u>, street, city)</p> <p>WORKS (<u>employee-name</u>, company-name, salary)</p> <p>COMPANY (<u>company-name</u>, city)</p> <p>MANAGES (<u>employee-name</u>, manager-name)</p> <p>Give an expression in SQL for each of the following queries.</p> <ul style="list-style-type: none"> <li>a) Find the names of all employees who work for First Bank Corporation.</li> <li>b) Find the names and cities of residence of all employees who work for First Bank Corporation.</li> <li>c) Find the names, street addresses, and cities of residence of all employees who work for First Bank Corporation and earn more than 70,000.</li> <li>d) Find all employees in the database who live in the same cities as the companies for which they work.</li> <li>e) Find all employees in the database who live in the same cities and on the same streets as do their managers.</li> <li>f) Find all employees in the database who do not work for First Bank Corporation.</li> <li>g) Find all employees in the database who earn more than each employee of Small Bank Corporation.</li> </ul>
3.	Write SQL queries for Library Database schema.

	<p>The Library Database schema includes the following tables:            BOOK (Book_id, Title, Publisher_Name, Pub_Year)            BOOK_AUTHORS(Book_id, Author_Name)            PUBLISHER (Name, Address, Phone)            BOOK_COPIES (Book_id, Programme_id, No-of_Copies)            BOOK_LENDING (Book_id, Programme_id, Card_No, Date_Out, Due_Date)            LIBRARY_PROGRAMME(Programme_id, Programme_Name, Address)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>Retrieve details of all books in the library – Book_id, title, name of publisher, authors, number of copies in each Programme, etc.</li> <li>Get the particulars of borrowers who have borrowed more than 3 books, but from July 2023 to Dec 2023.</li> <li>Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.</li> </ol>
4.	<p>Write SQL queries for Sales Database schema.            Create Sales table with the following fields(Sales No, Salesname, Branch, Salesamount, DOB)</p> <ol style="list-style-type: none"> <li>Insert five records</li> <li>Calculate total sales amount in each branch</li> <li>Calculate average sales amount in each branch</li> <li>Display all the salesmen, DOB who are born in the month of December as day in character format i.e. 21-Dec-09</li> <li>Display the name and DOB of salesman in alphabetical order of the month</li> </ol>
5.	<p>Write SQL queries for Student Database schema.            Consider the following relations:            STUDENT (snum: integer, sname: string, major: string, level: string, age: integer)            CLASS (name: string, meets at: string, room: string, fid: integer)            ENROLLED (snum: integer, cname: string)            FACULTY (fid: integer, fname: string, deptid: integer)            The meaning of these relations is straightforward; for example, Enrolled has one record per student-class pair such that the student is enrolled in the class.</p> <p>Write the following queries in SQL. No duplicates should be printed in any of the answers.</p> <ol style="list-style-type: none"> <li>Find the names of all Juniors (level = JR) who are enrolled in a class taught by I. Teach.</li> <li>Find the age of the oldest student who is either a History major or enrolled in a course taught by I. Teach.</li> <li>Find the names of all classes that either meet in room R128 or have five or more students enrolled.</li> <li>Find the names of all students who are enrolled in two classes that meet at the same time.</li> <li>Find the names of faculty members who teach in every room where some class is taught.</li> <li>Find the names of faculty members for whom the combined enrollment of the courses they teach is less than five.</li> </ol>
6.	<p>Write SQL queries for Flight Database schema.            Consider the following relations:            FLIGHTS (flno: integer, from: string, to: string, distance: integer, departs: time, arrives: time, price: real)            AIRCRAFT (aid: integer, aname: string, cruisingrange: integer)            CERTIFIED (eid: integer, aid: integer)            EMPLOYEES (eid: integer, ename: string, salary: integer)</p>



	<p>Note that the Employees relation describes pilots and other kinds of employees; every pilot is certified for some aircraft, and only pilots are certified to fly. Write each of the following queries in SQL.</p> <ol style="list-style-type: none"> <li>Find the names of aircraft such that all pilots certified to operate them have salaries of more than 80,000.</li> <li>For each pilot certified for more than three aircraft, find the eid and the maximum cruising range of the aircraft for which she or he is certified.</li> <li>Find the names of pilots whose salary is less than the price of the cheapest route from Los Angeles to Honolulu.</li> <li>For all aircraft with cruising ranges over 1000 miles, find the aircraft's name and the average salary of all pilots certified for this aircraft.</li> <li>Find the names of pilots certified for some Boeing aircraft.</li> <li>Find the aids of all aircraft that can be used on routes from Los Angeles to Chicago.</li> </ol>
7.	<p>Write SQL queries for Order Database schema. Consider the following schema for Order Database:</p> <p>SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER (Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>Count the customers with grades above Bangalore's average.</li> <li>Find the names and numbers of all salesmen with more than one customer.</li> <li>List all the salesmen and indicate those who have and do not have customers in their cities (Use UNION operation.)</li> <li>Finds the salesman who has the customer with the highest order of the day.</li> <li>Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.</li> </ol>
8.	<p>Write SQL queries for Movie Database schema. Consider the schema for Movie Database:</p> <p>ACTOR (Act_id, Act_Name, Act_Gender) DIRECTOR (Dir_id, Dir_Name, Dir_Phone) MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST (Act_id, Mov_id, Role) RATING (Mov_id, Rev_Stars)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>List the titles of all movies directed by 'Karan Johar'.</li> <li>Find the movie names where one or more actors acted in two or more movies.</li> <li>List all actors who acted in a movie before 2020 and in a movie after 2023 (use JOIN operation).</li> <li>Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title.</li> <li>Update rating of all movies directed by 'Karan Johar' to 5</li> </ol>
9.	<p>Write SQL queries for Employee Database schema. Consider the Employee Database.</p> <p>EMPLOYEE (employee-name, street, city) WORKS (employee-name, company-name, salary) COMPANY (company-name, city) MANAGES (employee-name, manager-name)</p> <p>Give an expression in SQL for each of the following queries.</p> <ol style="list-style-type: none"> <li>Modify the database so that Jones now lives in Newtown.</li> <li>Give all employees of First Bank Corporation a 10 percent raise.</li> <li>Give all managers of First Bank Corporation a 10 percent raise.</li> <li>Give all managers of First Bank Corporation a 10 percent raise unless the salary becomes greater than \$100,000; in such cases, give only a 3 percent raise.</li> </ol>



	e) Delete all tuples in the works relation for employees of Small Bank Corporation
10.	<p>Write SQL queries for Employee Database schema.</p> <p>Consider the schema for Company Database:</p> <p>EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo)</p> <p>DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate)</p> <p>DLOCATION(DNo,DLoc)</p> <p>PROJECT (PNo, PName, PLocation, DNo)</p> <p>WORKS_ON (SSN, PNo, Hours)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project.</li> <li>Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise.</li> <li>Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department</li> <li>Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).</li> <li>For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs. 6,00,000.</li> </ol>
11.	<p>Write SQL queries for Teacher Database schema.</p> <p>Create Teacher table with the following fields (Name, DeptNo, Date of joining, DeptName, Location, Salary)</p> <ol style="list-style-type: none"> <li>Insert five records</li> <li>Give Increment of 25% salary for Mathematics Department.</li> <li>Perform Rollback command.</li> <li>Give Increment of 15% salary for Commerce Department.</li> <li>Perform commit command</li> </ol>
12.	<p>Write SQL queries for Client_master Database schema.</p> <p>Create Client_master with the following fields (ClientNO, Name, Address, City, State, bal_due)</p> <ol style="list-style-type: none"> <li>Insert five records</li> <li>Find the names of clients whose bal_due &gt; 5000.</li> <li>Change the bal_due of ClientNO "C123" to Rs. 5100.</li> <li>Change the name of Client_master to Client12.</li> <li>Display the bal_due heading as "BALANCE"</li> </ol>