

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous) Dundigal, Hyderabad - 500 043

Computer Science and Engineering TUTORIAL QUESTION BANK

| Course Name | : | DATABASE MANAGEMENT SYSTEMS |
|----------------|---|--|
| Course Code | : | ACS005 |
| Class | : | B. Tech IV Semester |
| Branch | : | Computer Science and Engineering |
| Academic Year | • | 2018–2019 |
| | | Dr. K Suvarchala , Professor, CSE |
| Course Faculty | : | Ms. K Mayuri, Assistant Professor, CSE |

COURSE OBJECTIVES:

The course should enable the students to:

| I | Discuss the basic database concepts, applications, data models, schemas and instances. |
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| II | Design Entity Relationship model for a database. |
| III | Demonstrate the use of constraints and relational algebra operations. |
| IV | Describe the basics of SQL and construct queries using SQL. |
| V | Understand the importance of normalization in databases. |

COURSE LEARNING OUTCOMES:

At the end of the course the students are able to:

| CLOs | Description |
|-----------|--|
| ACS005.01 | Define the terminology, features, and characteristics of database system |
| ACS005.02 | Differentiate database systems from file systems by enumerating various features provided by database |
| | systems. |
| ACS005.03 | Describe Data Models, Schemas, Instances, Three Schema Architecture and DBMS Component Modules |
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| ACS005.04 | Analyze an information storage problem and derive an information model expressed in the form of an |
| | entity relation diagram. |
| ACS005.05 | Model the real world database systems using Entity Relationship Diagrams (ERD) from the requirements |
| | specification. |
| ACS005.06 | Describe basics of the relational data model. |
| ACS005.07 | Define and illustrate the Relational Data Model, Constraints and Schemas |
| ACS005.08 | Transform an information model into a relational database schema and implement schema using data |
| | definition language and/or utilities. |
| ACS005.09 | Formulate solutions to a broad range of query problems using relational algebra. |
| ACS005.10 | Apply relational calculus to solve broad range of query problems. |
| ACS005.11 | Illustrate the Functional Dependencies, Inference Rules, Minimal Sets of FDs |
| ACS005.12 | Understand normalization theory and criticize a database design and improve the design by normalization. |
| ACS005.13 | Explain various Normal Forms and Apply to normalize a database. |
| ACS005.14 | Understand the SQL Data definition statements to formulate solutions to a broad range of query and data |
| | update problems |
| ACS005.15 | Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and |
| | query a database. |
| ACS005.16 | Use SQL queries for data aggregation, calculations, views, sub-queries, embedded queries, manipulation, |

| | and report generation. |
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| ACS005.17 | Demonstrate PL/SQL including stored procedures, stored functions, cursors, packages. |
| ACS005.18 | Gain knowledge on transaction processing to maintain consistency and integrity of data in database |
| | systems. |
| ACS005.19 | Describe concurrency control techniques to implement data integrity in database systems. |
| ACS005.20 | Illustrate various backup and recovery techniques for database systems. |
| ACS005.21 | Analyze transaction processing, concurrency control, Database recovery techniques |
| ACS005.22 | Define disk storage devices, files of records, unordered files, ordered files and hashed files and |
| | organizations |
| ACS005.23 | Familiar with basic database storage structures and access techniques- file and page organizations, |
| | indexing methods |
| ACS005.24 | Illustrate various operations in implementing data indices using various hashing techniques. |
| ACS005.25 | Possess the knowledge and skills for employability and to succeed in national and international level |
| | competitive examinations. |

TUTORIAL QUESTION BANK

| UNIT – I | | | | | | |
|----------|---|------------|------------|--|--|--|
| | Conceptual Modeling | | | | | |
| | PART – A (Short Answer Questions) | | | | | |
| | | Blooms | Course | | | |
| Q.No | Questions | Taxonomy | Learning | | | |
| Q.110 | Questions | Level | Outcomes | | | |
| | | | (CLOs) | | | |
| 1. | List the advantages of DBMS. | Understand | CACS005.01 | | | |
| 2. | List the database Applications. | Remember | CACS005.01 | | | |
| 3. | Define instances and schemas of database. | Remember | CACS005.03 | | | |
| 4. | Discuss Data Independence. | Understand | CACS005.02 | | | |
| 5. | How application programs access data base? | Remember | CACS005.01 | | | |
| 6. | Define (i) Database (ii) DBMS. | Remember | CACS005.03 | | | |
| 7. | What are main components of Database storage structure? | Understand | CACS005.03 | | | |
| 8. | What are the main responsibilities of Theaction management component? | Understand | CACS005.03 | | | |
| 9. | Outline main functions of Query Processor. | Remember | CACS005.03 | | | |
| 10. | Define (i) Entity (ii) Attribute | Remember | CACS005.04 | | | |
| 11. | Define Relationship and Relationship set. | Remember | CACS005.04 | | | |
| 12. | Discuss about Data Definition language. | Understand | CACS005.02 | | | |
| 13. | Discuss about Data Manipulation language. | Remember | CACS005.02 | | | |
| 14. | List responsibilities of a DBA. | Remember | CACS005.02 | | | |
| 15. | Outline the History of Data base Systems. | Understand | CACS005.01 | | | |
| 16. | Discuss how can you change the data in the table. | Understand | CACS005.02 | | | |
| 17. | List various types of attributes. | Remember | CACS005.04 | | | |
| 18. | Discuss How can you alter and destroy tables?. | Remember | CACS005.02 | | | |
| 19. | Define a data model? List the types of data model used. | Understand | CACS005.03 | | | |
| 20. | List the levels of data abstraction. | Understand | CACS005.02 | | | |
| | PART – B (Long Answer Questions) | | | | | |
| 1. | Compare and Contrast file Systems with database systems. | Understand | CACS005.02 | | | |
| 2. | Define Data Abstraction and discuss levels of Abstraction. | Remember | CACS005.03 | | | |
| 3. | Discuss about different types of Data models. | Remember | CACS005.03 | | | |
| 4. | Describe the Structure of DBMS. | Understand | CACS005.02 | | | |
| 5. | Discuss additional features of the ER-Models. | Remember | CACS005.04 | | | |
| 6. | Discuss about the Concept Design with the ER Model. | Remember | CACS005.05 | | | |
| 7. | Explain in detail Different types of Data Independence with examples. | Understand | CACS005.03 | | | |
| 8. | Explain different types of database users and write the functions of DBA. | Understand | CACS005.02 | | | |
| 9. | Explain about different types of integrity constraints. | Remember | CACS005.07 | | | |
| 10. | Discuss about Different keys used in data base design with examples. | Remember | CACS005.06 | | | |
| 11. | Distinguish strong entity set with weak entity set? Draw an ER diagram to illustrate weak entity set. | Understand | CACS005.03 | | | |

| 13. List one-to-passes for each mark of modifications made at conceptual level makes application in the relational models? | | | | | |
|--|-------------|---|----------------------|--------------------------|--|
| 13. List and explain the design issues of entity relationship. Remember Develop ER-Diagram for a hospital with a set of patients and a set of medical doctors. Associated with each patient a log of the various tests and examinations conducted. PART - C (Problem Solving and Critical Thinking Questions) | 12 | Differentiate relation schema and relational instance. Define the terms arity and | Understand | CACS005.06 | |
| Develop ER-Diagram for a hospital with a set of patients and a set of medical doctors. Associated with each patient a log of the various tests and examinations conducted. PART – C (Problem Solving and Critical Thinking Questions) Design an E-R diagram for keeping track of the exploits of your favorite sports team. You should store the matches played, the scores in each match, the players in each match and individual player statistics for each match. Summary statistics should be modeled as derived attributes. Let EI and E2 be two entities in an E/R diagram with simple single-valued attributes. Ramany-to-many, RI and R2 are two relationships between EI and E2, where RI is one-to-many and R2 is many-to-many, RI and R2 are on two relationships between EI and E2, where RI is one-to-many and R2 is many-to-many, RI and R2 do not have any attributes of theirown. Calculate the minimum number of tables required to represent this situation in the relational model. Analyze and find whether modifications made at conceptual level makes application programs written by users at viewlevel to be modified in a database. Analyze your anser with illustration. We can convert any weak entity set to strong entity set by simply adding appropriate attributes. Analyze why, then, do we have weak entity sets? What are the responsibilities of a DBA*1I five assume that the DBA is never sinterested in running his or her own queries, does the DBA still need to understand query optimization? Why? Describe the structure of a DBMS. If your operating system is upgraded to support some new functions on OS flies (e.g., the ability to force some sequence of bytes to disk), which layer(s) of the DBMS would you have to rewrite to lake advantage of these new functions. Part by relational model became more popular comparing with other record based models? Describe the process to convert ER model into relation schema. Discuss the disadvantages of file processing system, and explain how these disadvantages of models? Design a relational database | | | Domombos | CACCO05 04 | |
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| What are the responsibilities of a DBA? If we assume that the DBA is never interested in running his or her own queries, does the DBA still need to understand query optimization? Why? Describe the structure of a DBMS. If your operating system is upgraded to support some new functions on OS files (e.g., the ability to force some sequence of bytes to disk), which layer(s) of the DBMS would you have to rewrite to take advantage of these new functions. Why relational model became more popular comparing with other record based models? Bescribe the process to convert ER model into relation schema. Discuss the disadvantages of file processing system, and explain how these disadvantages are avoided in DBMS? Design a relational database for a university registrar's office the office maintain data about each class, including the instructor, the number of sudents enrolled, and time and place of the class meatings. For each student - class pair, a grade is recorded. WINTT - II Relational Approach PART - A (Short Answer Questions) 1. Define relational database query. 2. State the purpose of SELECT operation in Relational algebra. 3. State the purpose of PROJECT operation in Relational algebra. 4. Define a relational calculus. Define a relational calculus. Define a relational calculus. Define a tuple relational calculus. Remember CACS005.6 Remember CACS005.6 Remember CACS005.7 Remember CACS005.7 Discuss the use of rename operation. Remember CACS005.8 Remember CACS005.9 Remember CACS005.9 Remember CACS005.1 Rem | 4 | | Understand | CACS005.04 | |
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| UNIT – II Relational Approach PART – A (Short Answer Questions) 1. Define relational database query. 2. State the purpose of SELECT operation in Relational algebra. 3. State the purpose of PROJECT operation in Relational algebra. 4. Define a relational calculus. 5. Discuss the use of rename operation. 6. Illustrate division operation. 7. Discuss about expressive power of algebra and calculus. 8. Define a tuple relational calculus. 9. Illustrate union operation and intersection operation. 10. Illustrate cross-product operation. 11. List set operators in relational algebra. 12. List aggregate functions used in Relational Algebra. 13. List out types of joins. 14. Illustrate set difference operation. 15. Define a domain relational calculus. PART – B (Long Answer Questions) Remember CACS005. Remember CACS005. CACS005. Remember CACS005. Remember CACS005. Remember CACS005. Remember CACS005. Understand CACS005. Remember CACS005. CACS005. Understand CACS005. CACS005. Understand CACS005. CACS005. CACS005. Understand CACS005. CACS0 | 10 | | Remember | CACS005.05 | |
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| 15. Define a domain relational calculus. PART – B (Long Answer Questions) Understand CACS005. | - | ** | | CACS005.09 | |
| PART – B (Long Answer Questions) | | | | CACS005.09 | |
| | | Define a domain relational calculus. | Understand | CACS005.10 | |
| | 15. | | | | |
| | 15. | PART – B (Long Answer Questions) | | | |
| | 1 | PART – B (Long Answer Questions) Illustrate different set operations in Relational algebra with an example. | Understand | CACS005.09 | |
| 3 Discuss about Domain Relational calculus in detail. Remember CACS005. | 1 2 | PART – B (Long Answer Questions) Illustrate different set operations in Relational algebra with an example. Define Join. Explain different types of joins in relational algebra. | Remember | CACS005.09 | |
| | 1 2 3 | PART – B (Long Answer Questions) Illustrate different set operations in Relational algebra with an example. Define Join. Explain different types of joins in relational algebra. Discuss about Domain Relational calculus in detail. | Remember Remember | CACS005.09 CACS005.10 | |
| 4 Discuss the difference between Relational Algebra and Relational Calculus. Remember CACS005. | 1 2 3 | PART – B (Long Answer Questions) Illustrate different set operations in Relational algebra with an example. Define Join. Explain different types of joins in relational algebra. Discuss about Domain Relational calculus in detail. | Remember Remember | CACS005.09 | |

| 5 | Illustrate Extended relational operations with examples. | Understand | CACS005.09 |
|----|---|------------|------------|
| 6 | Discuss about Complex integrity constraints in SQL. | Remember | CACS005.06 |
| 7 | Discuss structure of query in TRC and DRC with example. | Understand | CACS005.05 |
| 8 | a.Define a query in Tuple relational Calculus.b.Write a query in TRC to find the names of sailors who have reserved both a red and green boat?c.Write a query in TRC to find the names of sailors who have reserved all boats? | Remember | CACS005.10 |
| 9 | A Define query in Domain Relational Calculus. b. Write a query in DRC to find the names of sailors who have reserved a red boat? c. Write a query in DRC,to find the names of sailors who have not reserved a red boat? | Remember | CACS005.10 |
| 10 | a. Explain Relational calculus.b. Write a TRC query to find the names of sailors who have reserved boat 103?c. Write a DRC query to find the names of sailors who have reserved boat 103? | Remember | CACS005.10 |
| 11 | Let R=(ABC) and S=(DEF) let r(R) and s(S) both relations on schema R and S. Give an expression in the Tuple relational calculus that is equivalent to each of the following. i) $\sigma B=19(r)$ ii) $\Pi A,F,(\sigma C=D(r\times s))$ iii) $r\cap s$ | Remember | CACS005.10 |
| 12 | Consider the following schema instructor (ID, name, dept_name), teaches (ID, course_id, sec_id, semester, year), section (course_id, sec_id, semester, year), student (ID, name, dept_name), takes (ID, course_id, sec_id, semester, year, grade) Write the following query in RA,TRC and DRC a) Find the names of the instructors not teaching any course. | Remember | CACS005.10 |
| | PART – C (Problem Solving and Critical Thinking Questions) | 1 | |
| 1 | Given the Students relation as shown below StudentID StudentName StudentEmail StudentAge CPI 2345 Shankar shankar@math X 9.4 1287 Swati swati@ee 19 9.5 7853 Shankar shankar@cse 19 9.4 9876 Swati swati@mech 18 9.3 8765 Ganesh ganesh@civil 19 8.7 For (Student Name, Student Age) to be the key for this instance, analyze and find the value of X not be equal to student age. | Remember | CACS005.07 |
| 2 | Given the relations employee(name, salary, deptno) department (deptno, deptname, address) Solve which query cannot be expressed using the basic relational algebra operations. | Remember | CACS005.09 |
| 3 | Write Query in relational algebra to find second highest salary of Employee from Employee relation. | Understand | CACS005.09 |
| 4 | Consider the following schema given. The primary keys are underlined. Sailors(sailor-id, sailor-name, sailor-rating, sailor-age) Boats(boat-id, boat-name, boat-color) Reserves(sailor-id, boat-id, day) Write queries in Relational Algebra. i. Find the names of sailors who have reserved boat number 120 ii. Find the names of sailors who have not reserved a green boat iii. Find the names of sailors who have not reserved a green boat iv. Find the names of sailors with the highest rating | Remember | CACS005.09 |
| 5 | Consider the following database. Employee (employee-name, street, city) Works (employee-name, company-name, salary) | Understand | CACS005.10 |

| | Company (company-name, city) | | |
|---|--|--|--|
| | Manager (employee-name, manager-name) | | |
| | Give an expression in the relational algebra, the tuple relational calculus, and the | | |
| | domain relational calculus, for the following query. | | |
| | Find the names of all employees who work for estate bank. Write the RA expression for the following Queries. | | |
| | Sailor Schema (sailor id, Sailorname, Rating.Age) | | |
| | Reserves (Sailor id, Boat id, Day) | | |
| | Boat Schema (Boat id, Boatname.color) | 77 1 . 1 | G + GG007 00 |
| 6 | i. Find the names of sailors who have reserved boat name 103; | Understand | CACS005.09 |
| | ii. Find the sailor id of sailors who have reserved a red boat; | | |
| | iii. Find the colors of boats reserved by the sailor rubber. | | |
| | iv. Find the names of sailors who have reserved a red boat. | | |
| | For the following relational database, give the expressions in RA. student(stuno, stuname, major,level,age) | | |
| | Class(Classname, meets at, Room, fid) | | |
| | Faculty(fid,fname,deptid) | | |
| | i. Find the names of all uniors (level = JR) Who are enrolled in a class taught by | | |
| | I.Teach. | | |
| 7 | ii. Find the age of the oldest student who is either a history major or is enrolled in a | Remember | CACS005.09 |
| | course taught by I.Tech? iii. Find the names of all classes that either meet in room R128 or have five or more | | |
| | students enrolled? | | |
| | iv. Find the names of faculty members whom the combined enrollment of the | | |
| | course that they is less than 5? | | |
| | v. Print the level and the average age of students for that level, for each level? | | |
| | Write the RA expressions for the following relational database. | | |
| | sailor schema (sailor id, Boat id, sailorname, rating, age) | | |
| | Recerves (Sailor id, Boat id, Day) Boat Schema (boat id, Boatname, color) | | |
| 8 | i. Find the age of the youngest sailor for each rating level? | Understand | CACS005.09 |
| Ü | ii. Find the age of the youngest sailor who is eligible to vote for each rating level | Charlana | C11C5005.05 |
| | with at lead two such sailors? | | |
| | iii. Find the No.of reservations for each red boat? | | |
| | iv. Find the average age of sailor for each rating level that at least 2 sailors. UNIT – III | | |
| | | | l . |
| | | | |
| | Basic SQL Query | | |
| 1. | | Remember | CACS005.15 |
| 1. 2. | Basic SQL Query PART – A (Short Answer Questions) | Remember Remember | CACS005.15 CACS005.14 |
| | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. | | CACS005.14 CACS005.16 |
| 2. 3. 4. | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. | Remember Understand Remember | CACS005.14 CACS005.16 CACS005.14 |
| 2. 3. 4. 5. | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. | Remember Understand Remember Remember | CACS005.14 CACS005.16 |
| 2. 3. 4. 5. 6. | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? | Remember Understand Remember | CACS005.14 CACS005.16 CACS005.14 |
| 2. 3. 4. 5. | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. | Remember Understand Remember Remember | CACS005.14 CACS005.16 CACS005.14 CACS005.16 |
| 2. 3. 4. 5. 6. | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? | Remember Understand Remember Remember Understand | CACS005.14 CACS005.16 CACS005.14 CACS005.16 |
| 2. 3. 4. 5. 6. | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their | Remember Understand Remember Remember | CACS005.14 CACS005.16 CACS005.14 CACS005.16 CACS005.16 |
| 2. 3. 4. 5. 6. 7. | PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. | Remember Understand Remember Remember Understand Understand | CACS005.14 CACS005.16 CACS005.14 CACS005.16 CACS005.16 |
| 2. 3. 4. 5. 6. 7. | Basic SQL Query PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. Write a SQL statement to find the employees who are not clerks, analysts or salesmen. | Remember Understand Remember Remember Understand | CACS005.14 CACS005.16 CACS005.14 CACS005.16 CACS005.16 |
| 2. 3. 4. 5. 6. 7. | PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. Write a SQL statement to find the employees who are not clerks, analysts or salesmen. Write a SQL statement to display the names of all the employees and position where | Remember Understand Remember Remember Understand Understand Understand | CACS005.14 CACS005.16 CACS005.14 CACS005.16 CACS005.16 CACS005.16 |
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| 2. 3. 4. 5. 6. 7. | PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. Write a SQL statement to find the employees who are not clerks, analysts or salesmen. Write a SQL statement to display the names of all the employees and position where | Remember Understand Remember Remember Understand Understand Understand | CACS005.14 CACS005.16 CACS005.14 CACS005.16 CACS005.16 CACS005.16 |
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| 2. 3. 4. 5. 6. 7. 8. | PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. Write a SQL statement to find the employees who are not clerks, analysts or salesmen. Write a SQL statement to display the names of all the employees and position where the string 'AR' occurs in the name. | Remember Understand Remember Remember Understand Understand Understand Understand | CACS005.14 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.16 |
| 2. 3. 4. 5. 6. 7. 8. 9. | PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. Write a SQL statement to find the employees who are not clerks, analysts or salesmen. Write a SQL statement to display the names of all the employees and position where the string 'AR' occurs in the name. List out all classes in select statement. | Remember Understand Remember Remember Understand Understand Understand Understand Remember | CACS005.14 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.15 CACS005.11 |
| 2. 3. 4. 5. 6. 7. 8. 9. 10. | PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. Write a SQL statement to find the employees who are not clerks, analysts or salesmen. Write a SQL statement to display the names of all the employees and position where the string 'AR' occurs in the name. List out all classes in select statement. Define redundancy. Define functional dependency. Why are some functional dependencies trivial? | Remember Understand Remember Remember Understand Understand Understand Understand Remember Remember | CACS005.14 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.11 CACS005.11 |
| 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. | PART – A (Short Answer Questions) Illustrate Create statement with example. Demonstrate DML statements in SQL Give an example. Discuss various Aggregate functions used in SQL. Define primary key. State the syntax of foreign key constraint. What are the data types in SQL? Write a SQL statement to find employees whose commission is greater than their salaries. Write a SQL statement to find the employees who are not clerks, analysts or salesmen. Write a SQL statement to display the names of all the employees and position where the string 'AR' occurs in the name. List out all classes in select statement. Define redundancy. Define functional dependency. Why are some functional dependencies trivial? Discuss normalization. | Remember Understand Remember Remember Understand Understand Understand Remember Remember Remember Understand | CACS005.14 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.16 CACS005.11 CACS005.11 CACS005.11 CACS005.12 |

| 16. | Define First Normal Form. | Understand | CACS005.13 |
|-----|---|------------|------------|
| 17. | Define Second Normal Form. | Remember | CACS005.13 |
| 18. | Define Third Normal Form. | Remember | CACS005.13 |
| 19. | Define Fourth Normal Form. | Understand | CACS005.13 |
| 20. | Identify the Normal Forms of the relation R. | Understand | CACS005.12 |
| | $R(ABCD) FD : \{A \rightarrow B, B \rightarrow C\}$ | | |

| | PART – B (Long Answer Questions) | | |
|----|---|------------|------------|
| 1 | Define a View in SQL. Write about updates on views. | Remember | CACS005.16 |
| 2 | Illustrate Group by and Having clauses with examples. | Understand | CACS005.15 |
| 3 | Discuss about Complex integrity constraints in SQL. | Remember | CACS005.15 |
| 4 | a.Define a nested query. b.Write a nested query to find the names of sailors who have reserved both a red and green boat. c.Write a nested query to find the names of sailors who have reserved all boats. | Remember | CACS005.16 |
| 5 | Discuss various DML statement in SQL and explain with examples. | Remember | CACS005.15 |
| 6 | Explain referential integrity constraint ,unique key. Is unique+not null is same as primary key | Remember | CACS005.15 |
| 7 | What are nested queries? What is correlation in nested queries? Explain. | Remember | CACS005.16 |
| 8 | Consider the following schema instructor (ID, name, dept_name), teaches (ID, course_id, sec_id, semester, year), section (course_id, sec_id, semester, year), student (ID, name, dept_name), takes (ID, course_id, sec_id, semester, year, grade) Write the following queries in SQL a) Find the names of the students not registered in any section b) Find the total number of courses taught department wise c) Find the total number of courses registered department wise. | Remember | CACS005.14 |
| | | | |
| 7 | Define decomposition and how does it address redundancy? Discuss the problems that may be caused by the use of decompositions. | Remember | CACS005.11 |
| 8 | Define functional dependencies. How are primary keys related to FD's? | Understand | CACS005.11 |
| 9. | Define normalization? Explain 1NF, 2NF, 3NF Normal forms. | Remember | CACS005.13 |
| 10 | Describe properties of decompositions. | Remember | CACS005.13 |
| 11 | Explain about Schema refinement in Database design. | Understand | CACS005.12 |
| 12 | Illustrate Multivalued dependencies and Fourth normal form with example. | Remember | CACS005.13 |
| 13 | Compute the closer of the following set of functional dependencies for a relation scheme. R(A,B,C,D,E) F={ A->BC,CD->E,B->D,E-> A} List out the candidate keys of R. | Remember | CACS005.11 |
| | | | i |
| 14 | Compute the closer of the following set of functional dependencies for a relation scheme. R(A,B,C,D,E,F,G,H), F={ AB->C, BD->EF, AD->G,A->H} List the candidate keys of R. | Remember | CACS005.11 |
| 14 | scheme. R(A,B,C,D,E,F,G,H), F={ AB→C, BD→EF, AD→G,A→H} List the candidate keys of R. Convert the following schema into third normal form. Stdcourse (StdSSN , StdCity, StdClass , OfferNo , OffTerm, OffYear, CourseNo, CrsDesc , EnrGrade) With FDs are: StdSSN → StdCity, StdClass OfferNo → OffTerm, OffYear, CourseNo, CrsDesc CourseNo → CrsDesc StdSSN, OfferNo → EnrGrade | Remember | CACS005.11 |
| | scheme. R(A,B,C,D,E,F,G,H), F={ AB→C, BD→EF, AD→G,A→H} List the candidate keys of R. Convert the following schema into third normal form. Stdcourse (StdSSN , StdCity, StdClass , OfferNo , OffTerm, OffYear, CourseNo, CrsDesc , EnrGrade) With FDs are: StdSSN → StdCity, StdClass OfferNo → OffTerm, OffYear, CourseNo, CrsDesc CourseNo → CrsDesc | Remember | |

| | D (C:1:1 D(1 D) | 1 | 1 |
|---|---|---------------|--------------|
| | Reserves (Sailor id, Boat id, Day) Boat Schema (Boat id, Boatname.color) | | |
| | i. Find the names of sailors who have reserved boat name 103; | | |
| | ii. Find the sailor id of sailors who have reserved a red boat; | | |
| | iii. Find the colors of boats reserved by the sailor rubber? | | |
| | iv. Find the names of sailors who have reserved a red boat? | | |
| | For the following relational database, give the expressions in SQL. | | |
| | student(stuno, stuname, major,level,age) | | |
| | Class(Classname, meets at, Room, fid) | | |
| | Faculty(fid,fname,deptid) | | |
| | i. Find the names of all uniors (level = JR) Who are enrolled in a class taught by | | |
| | I. Teach? | | |
| 2 | ii. Find the age of the oldest student who is either a history major or is enrolled in a | Remember | CACS005.16 |
| 2 | course taught by I.Tech? | Remember | CAC5005.10 |
| | iii. Find the names of all classes that either meet in room R128 or have five or more | | |
| | students enrolled? | | |
| | | | |
| | iv. Find the names of faculty members whom the combined enrollment of the | | |
| | course that they is less than 5? | | |
| | v. Print the level and the average age of students for that level, for each level? | | |
| | Write the SQL expressions for the following relational database. | | |
| | sailor schema (sailor id, Boat id, sailorname, rating, age) | | |
| | Recerves (Sailor id, Boat id, Day) | | |
| 2 | Boat Schema (boat id, Boatname, color) | The demand of | CA CC005 16 |
| 3 | i. Find the age of the youngest sailor for each rating level? | Understand | CACS005.16 |
| | ii. Find the age of the youngest sailor who is eligible to vote for each rating level | | |
| | with at lead two such sailors? | | |
| | iii. Find the No.of reservations for each red boat? | | |
| | iv. Find the average age of sailor for each rating level that at least 2 sailors. | | |
| | Consider the following schema: Suppliers(sid: integer, sname: string, address: string) | | |
| | Parts(pid: integer, pname: string, color: string) Catalog(sid: integer, pid: integer, cost: | | |
| | real) The Catalog relation lists the prices charged for parts by Suppliers. Answer the | | G + GG00# 16 |
| 4 | following questions: Give an example of an updatable view involving one relation. | Remember | CACS005.16 |
| | Give an example of an updatable view involving two relations. Give an example of | | |
| | an insertable-into view that is updatable. Give an example of an insertable-into view | | |
| | that is not updatable. | | |
| | Consider following relations in DB and solve the queries: | | |
| | Student (GR_NO, name, gender, address, city, class) | | |
| | Marks (GR_NO, sub1, sub2, sub3, total, per) | | |
| | 1) Display the student of 'FYBCA' and 'TYBCA'. (2 mark each) | | |
| 5 | 2) Display the marks of student whose gr_no>100. | Remember | CACS005.16 |
| | | | |
| | 3) Count the no of girls in FYBCA. | | |
| | 4) count the no: of first class students in TYBCA. | | |
| | 5) GIVE DETAILS OF STUDENTS WHO STOOD FIRST IN EACH CLASS. | | |
| | | | |
| | | | |
| | Consider a relation scheme R = (A, B, C, D, E, H) on which the following | | |
| 6 | functional dependencies hold: {A->B, BC-> D, E->C, D->A}. Write the | Remember | CACS005.11 |
| U | candidate keys of R. $(R-B)$, $BC-B$, $BC-B$, $B-B$. Which the | Remember | CACS005.11 |
| | Candidate keys of K. | | |
| | Consider the following relational schemes for a library detabases | | |
| | Consider the following relational schemes for a library database: | | |
| | Book (Title, Author, Catalog_no, Publisher, Year, Price) | | |
| | Collection (Title, Author, Catalog_no) | | |
| | the following are functional dependencies: | | |
| 7 | a. Title Author> Catalog_no | Remember | CACS005.13 |
| | b. Catalog_no> Title Author Publisher Year | | |
| | c. Publisher Title Year> Price | | |
| | Assume {Author, Title} is the key for both schemes. Apply the appropriate | | |
| | normal form for Book Cancellation. | | |
| | | | |
| | I . | 1 | l |

| Consider a sehema R (A, B, C, D) and functional dependencies A → B and Cobourd of the Cobourd | | | | |
|--|-----|--|--------------|--------------|
| 8 Solve and find whether the decomposition of R into R1 (A, B) and R2(C, D) belongs to which one or both (dependency preserving and loss less join)? 9 Show that: if α → β and α → γ then α → βγ. Consider the relation R(A,B,C,D,E,F) and FDs R1(α,C,D) PR (B,C,D) PR (B,C,D) and R3 (E,F,D) loss less' Explain the requirement of Lossless decomposition. 10 Perine BCNF. How does BCNF differ from 3NF? Explain with an example. Suppose the schema R(A,B,C,D,E) is decomposed into (A,B,C) and (A,D,E) show that the decomposition is of the dependency preserving decomposition if the following set of FD hold A→ BC,CD→E, B→ D, E→ A. 13 What is the need of Normalization in relational Database design? Explain "Dependency Preservation" in Database design? Suppose that we have the following three tuples in a legal instance of a relation schema S with three attributes ABC (listed in order): (1,2.3), (4,2.3), and (5,3.3). Which of the following dependencies can you infer does not hold over schema S? (a) A → B, (b) BC → A, (c) B → C **Transaction Management** **PART → A (Short Answer Questions)* 1 Define a Transaction. List the properties of transaction. Remember CACS005.18 2 Discuss different phases of transaction. Remember CACS005.18 3 Discuss cascade less schedules Remember CACS005.19 5 Define Two Phase Commit protocol. Remember CACS005.19 6 Demonstrate the implementation of Isolation. Remember CACS005.19 8 List different types of locks and write about compatability among them. Remember CACS005.19 10 Discuss the Procedure to test Serializability. Understand CACS005.19 11 Discuss where the implementation of Isolation. Remember CACS005.19 12 Demonstrate Conflict Scrializability. Understand CACS005.19 13 Discuss West reliability in detail. Understand CACS005.19 14 Discuss West reliability in detail. Understand CACS005.19 15 Discuss West reliability in detail. Understand CACS005.19 16 Describe Timestamp based locking protocols. Remember CACS005.19 17 Discuss West reliability in detail. Understand CACS005.19 18 | | | | |
| belongs to which one or both (dependency preserving and loss less join)? Show that: if α → β and α → γ then α → βγ. | o | | I Indonetond | CACCO05 11 |
| 9 Show that: if α → β and α → γ then α → βγ. Consider the relation R(A,B,C,D,E,F) and PDs R(A,C,D) RC (B,C,D) and R3 (E,F,D) loss less? Explain the requirement of Lossless decomposition. 10 Define B(NF). How does B(NF) differ from 3NF? Explain with an example. 11 Define B(NF). How does B(NF) differ from 3NF? Explain with an example. 12 show that the decomposition is not a dependency preserving decomposition if the following set of FD hold A → BC, CD → E, B → D, E → A. 13 What is the need of Normalization in relational Database design? Explain "Dependency Preservation" in Database design? 13 What is the need of Normalization in relational Database design? Explain "Dependency Preservation" in Database design? 14 Suppose that we have the following three tuples in a legal instance of a relation schema S with three attributes ABC (listed in order): (1,2,3), (4,2,3), and (5,3,3), which of the following dependencies can you infer does not hold over schema S? (a) A → B, (b) BC → A, (c) B → C 15 UNIT - IV 16 Transaction Management 17 PART - A (Short Answer Questions) 1 Define a Transaction. List the properties of transaction. 1 Define a Transaction. List the properties of transaction. 2 Discuss recoverable schedules. 2 Discuss recoverable schedules. 3 Discuss recoverable schedules. 4 Discuss recoverable schedules. 4 Discuss cacacale less achedules 5 Define Two Phase: Commit protocol. 5 Define Two Phase: Commit protocol. 6 Demonstrate the implementation of Isolation. 7 Discuss the Procedure to test Serializability. 10 Define a checkpoint. 11 Discuss the failures that can occur with loss of Non-volatile storage. 12 Discuss show failure Classification. 13 Discuss Provedure to test serializability. 14 Discuss Serializability in detail. 15 Discuss Fedinalizability in detail. 16 Define a checkpoint. 17 Discuss Serializability in detail. 18 Discuss Provedure that can occur with loss of Non-volatile storage. 19 Discuss Serializability in detail. 10 Describ Timistamp base of locking protocols. 1 | 8 | | Understand | CACS005.11 |
| Consider the relation R(A,B,C,D,E,F) and FDs A = BC, F → A, C → A → D ← E, E → D A D is the decomposition of R into R(A,C,D) R2 (B,C,D) and R3 (E,F,D) loss less? Explain the requirement of Lossless decomposition. CACS005.12 | | belongs to which one or both (dependency preserving and loss less join): | | |
| Consider the relation R(A,B,C,D,E,F) and FDs A = BC, F → A, C → A → D ← E, E → D A D is the decomposition of R into R(A,C,D) R2 (B,C,D) and R3 (E,F,D) loss less? Explain the requirement of Lossless decomposition. CACS005.12 | 0 | Show that if a R and a reather a Re | Damamhar | CACS005 11 |
| A → BC, F → A, C → AD → E, E → D AD is the decomposition of R into RLC, DD R2 (BC, DD) and R3 (E, F, D) loss less? Explain the requirement of Lossless decomposition. CACS005.12 | 9 | | Kemember | CACS005.11 |
| RI(A,C,D) R2 (B,C,D) and R3 (E,F,D) loss less? Explain the requirement of Lossless decomposition. CACS005.12 | | | | |
| decomposition. | 10 | | Understand | CACS005.12 |
| Suppose the schema R(A, B, C, D, E) is decomposed into (A, B, C) and (A, D, E) show that the decomposition is not a dependency preserving decomposition if the following set of FD hold A→ BC, C, D→ E, B→ D, E→ A. 13 What is the need of Normalization in relational Database design? Explain "Dependency Preservation" in Database design? Remember CACS005.07 | | | | |
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| What is the need of Normalization in relational Database design? Explain "Dependency Preservation" in Database design? | 12 | | Understand | CACS005.12 |
| Suppose that we have the following three tuples in a legal instance of a relation schema S with three attributes ABC (listed in order): (1,2,3), (4,2,3), and (5,3,3). | | | | |
| Suppose that we have the following three tuples in a legal instance of a relation schema S with three attributes ABC (listed in order): (1,2,3), (4,2,3), and (5,3,3). | 13 | | Remember | CACS005.07 |
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| Which of the following dependencies can you infer does not hold over schema S? (a) A → B, (b) BC → A, (c) B → C | | | | |
| Transaction Management PART – A (Short Answer Questions) 1 Define a Transaction. List the properties of transaction. 2 Discuss different phases of transaction. 3 Discuss different phases of transaction. 3 Discuss recoverable schedules. 4 Discuss cascade less schedules 5 Define Two Phase Commit protocol. 6 Demonstrate the implementation of Isolation. 8 Remember CACS005.19 6 Demonstrate the implementation of Isolation. 9 Remember CACS005.19 8 List different types of locks and write about compatability among them. 9 Discuss about Failure Classification. 10 Define a checkpoint. 11 Discuss the Procedure to test Serializability. 12 Demonstrate Conflict Serializability. 13 Discuss about Failure Standard CACS005.19 14 Discuss the Isolations occur with loss of Non-volatile storage. 15 Demonstrate Conflict Serializability. 16 Discuss the Isolations occur with loss of Non-volatile storage. 17 Discuss the Isolations occur with loss of Non-volatile storage. 18 Discuss discussed the Isolations of Standard CACS005.19 19 Discuss discussed the Isolations of Standard CACS005.19 20 Demonstrate Conflict Serializability. 21 Discuss View Serializability. 22 Discuss View Serializability. 23 Discuss View Serializability. 24 Discuss How do you implement Atomicity and Durability. 25 Discuss How do you implement Atomicity and Durability. 26 Discuss How do you implement Atomicity and Durability. 27 Discuss How and you implement Atomicity and Durability. 3 Illustrate Concurrent execution of transaction with examples. 4 Discuss two phase locking protocol and strict two phase locking protocols. 5 Discuss two phase locking protocol and strict two phase locking protocols. 6 Describe Timestamp based locking protocols. 7 Describe Timestamp based locking protocols. 8 Discuss how do you recover from Concurrent transaction. 9 Explain in detail Storage structure. 10 Discuss Deferred database modification and Immediate database modification. 11 Discuss how do you recover from Concurrent transactions. 12 Explain Buffer Management. 13 Explain the Ch | 14 | | Understand | CACS005 11 |
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| | | | | G + GG067 75 |
| PAKT – C (Problem Solving and Critical Thinking Questions) | 16 | | Remember | CACS005.20 |
| | | PART – U (Problem Solving and Critical Thinking Questions) | | |

| 1 | Consider the following transactions with data items P and Q initialized to zero: T1: read(P); read(Q); If P=0 then Q:=Q+1; write(Q); T2: read(Q); read(P); If Q=0 then P:=P+1; | Understand | CACS005.21 |
|---|---|------------|------------|
| | write(P); Solve and find any non-serial interleaving of T1 and T2 for concurrent execution leads to a serializable schedule or non serializable schedule. Explain. | | |
| 2 | Analyze which of the following concurrency control protocols ensure both conflict serializability and freedom from deadlock? Explain the following: a. 2-phase locking b. Time-stamp ordering | Remember | CACS005.19 |
| 3 | Suppose that we have only two types of transactions, T1 and T2. Transactions preserve database consistency when run individually. We have defined several integrity constraints such that the DBMS never executes any SQL statement that brings the database into an inconsistent state. Assume that the DBMS does not perform any concurrency control. Give an example schedule of two transactions T 1 and T 2 that satisfies all these conditions, yet produces a database instance that is not the result of any serial execution of T 1 and T 2. | Understand | CACS005.19 |
| 4 | Suppose that there is a database system that never fails. Analyze whether a recovery manager required for this system. | Remember | CACS005.21 |
| 5 | Explain the 'Immediate database Modification' technique for using the Log to Ensure transaction atomicity despite failures. | Remember | CACS005.19 |
| 6 | Consider the following actions taken by transaction T 1 on database objects X and Y : R(X), W(X), R(Y), W(Y) 1. Give an example of another transaction T 2 that, if run concurrently to transaction T without some form of concurrency control, could interfere with T 1. 2. Explain how the use of Strict 2PL would prevent interference between the two transactions. 3. Strict 2PL is used in many database systems. Give two reasons for its popularity. | Remember | CACS005.13 |
| 7 | Suppliers(sid: integer, sname: string, address: string) Parts(pid: integer, pname: string, color: string) Catalog(sid: integer, pid: integer, cost: real) The Catalog relation lists the prices charged for parts by Suppliers. For each of the following transactions, state the SQL isolation level that you would use and explain why you chose it. 1. A transaction that adds a new part to a supplier's catalog. 2. A transaction that increases the price that a supplier charges for a part. 3. A transaction that determines the total number of items for a given supplier. 4. A transaction that shows, for each part, the supplier that supplies the part at the lowest price | Understand | CACS005.19 |
| 8 | Answer each of the following questions briefly. The questions are based on the following relational schema: Emp(eid: integer, ename: string, age: integer, salary: real, did: integer) Dept(did: integer, dname: string, floor: integer) and on the following update command: replace (salary = 1.1 * EMP.salary) where EMP.ename = 'Santa' Give an example of a query that would conflict with this command (in a concurrency control sense) if both were run at the same time. 1. Explain what could go wrong, and how locking tuples would solve the problem. | Remember | CACS005.19 |

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| | 2. Give an example of a query or a command that would conflict with this | | |
| | command, such that the conflict could not be resolved by just locking | | |
| | individual tuples or pages but requires index locking. 3. Explain what index locking is and how it resolves the preceding conflict. | | |
| | Suppose that we have only two types of transactions, T 1 and T 2. Transactions | | |
| | preserve database consistency when run individually. We have defined several | | |
| | integrity constraints such that the DBMS never executes any SQL statement that | | |
| 9 | brings the database into an inconsistent state. Assume that the DBMS does not | Remember | CACS005.21 |
| | perform any concurrency control. Give an example schedule of two transactions T 1 | | |
| | and T 2 that satisfies all these conditions, yet produces a database instance that is not | | |
| | the result of any serial execution of T 1 and T 2. | | |
| 10 | What are the roles of the Analysis, Redo, and Undo phases in ARIES? | Understand | CACS005.20 |
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| | UNIT – V | | |
| | Data Storage and Query Processing | | |
| | PART – A (Short Answer Questions) | | |
| 1 | Discuss about data on External storage. | Understand | CACS005.22 |
| 2 | Illustrate Clustered Indexes. | Remember | CACS005.23 |
| 3 | Discuss the Primary and Secondary indexes. | Understand | CACS005.23 |
| 4 | Define Tree Indexing. | Understand | CACS005.22 |
| 5 | Describe Storage Hierarchy. | Remember | CACS005.23 |
| 6 | Discuss the intuition for Tree Indexes. | Understand | CACS005.22 |
| 7 | Define Indexed Sequential Access Method. | Understand | CACS005.23 |
| 8 | Discuss about Overflow pages and Locking considerations of ISAM. | Understand | CACS005.23 |
| 9 | Describe structure of B+ tree node. | Understand | CACS005.24 |
| 10 | Compare dynamic and static hash techniques. | Understand | CACS005.24 |
| 11 | List steps in Query processing. | Understand | CACS005.24 |
| 12 | Discuss the advantages of Heap file organization. | Remember | CACS005.24 |
| _ | PART – B (Long Answer Questions) | | |
| 1 | Write in detail about Hash based Indexing and Tree based Indexing. | Understand | CACS005.23 |
| 2 | Compare I/O costs for all File Organizations. | Understand | CACS005.22 |
| 3 | Explain in detail about ISAM. | Remember | CACS005.22 |
| 4 | Explain B+ trees? Discuss about this Dynamic Index Structure. | Understand | CACS005.23 |
| 5 | Demonstrate searching a given element in B+ trees. Explain with example. | Understand Remember | CACS005.23 |
| 6 | Illustrate insertion of an element in B+ trees with example. | | CACS005.23 CACS005.23 |
| 7 8 | Illustrate deletion of an element in B+ trees with example. | Understand | CACS005.23 |
| 9 | Write in detail about Static Hashing. | Understand Remember | |
| 10 | Explain in detail about Extendible Hashing. Explain in detail about Linear Hashing. | Understand | CACS005.24 CACS005.24 |
| 11 | Compare and Contrast Extendible Hashing with Linear Hashing. | Understand | CACS005.24 |
| 11 | How does Extendable hashing use a directory of buckets? How does it handles insert | Chacistana | C/1CB003.24 |
| 12 | and delete operations? | Understand | CACS005.24 |
| 13 | Explain how insert and delete operations are handled in a static hash index. | Understand | CACS005.24 |
| | PART – C (Problem Solving and Critical Thinking Questions) | | |
| 1 | Consider a B+-tree in which the maximum number of keys in a node is 5 | | |
| 1 | Calculate the minimum number of keys in any non-root node. | Understand | CACS005.23 |
| 2 | In the index allocation scheme of blocks to a file, Calculate on what maximum | Remember | |
| | possible size of the file depends. | | CACS005.22 |
| 3 | A clustering index is defined on the fields of which type? Analyze them. | Understand | CACS005.22 |
| 4 | Calculate the minimum space utilization for a B+ tree index? | Understand | CACS005233 |
| 5 | Explain about the B -tree and the structure of B +- tree in detail with an example. | Remember | CACS005.23 |
| | Consider the B+ tree index of order $d = 2$ shown in Figure 10.1. | | |
| | 1. Show the tree that would result from inserting a data entry with key 9 into this | | |
| 6 | tree. 2. Show the P tree that would result from inserting a data entry with key 2 into the | Understand | CACS005.23 |
| | 2. Show the B+ tree that would result from inserting a data entry with key 3 into the original tree. How many page reads and page writes does the insertion require? | | |
| | 3. Show the B+ tree that would result from deleting the data entry with key 8 from | | |
| | 5. 5.15.1. the D + tree that would result from determs the data entry with key 6 from | I | 1 |

