

# KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

## Deemed To Be University

**BHUBANESWAR-751024**

**School of Computer Engineering Spring Semester 2021-2022**

**Course Handout**

# Date: 25/12/2021

## Course code : CS 2004

**Base-lined date : 25/12/2021**

**Course Title : Database Management Systems**

**Course Coordinator : Dr. Aleena Swetapadma**

**Course Faculty : Mr. Arup Sarkar**

**Dr. Aleena Swetapadma**

**Dr. C.R. Pradhan**

**Mr. Gannath Bhuyan**

**Dr. Jayanta Mondal**

**Mr. Kunal Anand**

**Dr. Pradeep Kumar Mallick**

**Prof. (Dr) Samaresh Mishra**

**Dr. Sushruta Mishra**

**Mr. Kumar Devadutta**

**Dr. Leena Das**

**Mrs. Meghana Raj**

**Dr. Rajdeep Chatterjee**

**Ms. Santwana Sagnika**

**Mr. Jaydeep Das**

**Ms. Priyanka Roy**

**Dr. Minakhi Rout**

**Mr. Saugata Roy**

**Mr. Jay Sarraf**

**Mr. Sankalp Nayak**

**Dr. Abhaya Kumar Sahoo**

**Course offered to the School : Computer Engineering**

1. **Course Description:**

**Introduction:** Databases are fundamental to much of business and commerce. Database management systems control access to databases. Some people design and build databases. Other people design and build database management systems. People in a third category use database management systems to access the data in databases. The purpose of a database management system is to store and transform data into information to support making decision.

## Course Contents:

|  |  |  |
| --- | --- | --- |
| **Sr#** | **Major Area** | **Detailed Area** |
| 1 | Introduction | General introduction to database systems, Database- DBMS distinction, Approaches to building a database, Data models, Three- schema architecture of a database, Challenges in building a DBMS,  Various components of a DBMS. |
| 2 | ER Model | Conceptual data modeling – motivation, Entities, Entity types, Various  types of attributes, Relationships, Relationship types, E/R diagram notation, Extended E/R Model, Examples. |
| 3 | Relational Data Model | Concept of relations and its characteristics, Schema-instance distinction, Integrity Constraints, Converting the database specification in E/R and extended E/R notation to the relational schema, Relational algebra operators: Selection, Projection, Cross product, Types of Joins,  Division, Tuple relation calculus, Domain relational calculus, SQL. |
| 4 | Relational Database Design | Dependencies and Normal Forms, Importance of a good schema design, Problems encountered with bad schema designs, Motivation for normal forms, Dependency theory - functional dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, Minimal covers, Definitions of 1NF, 2NF, 3NF and BCNF, Decompositions and desirable properties of them, Multi-valued dependencies and 4NF, Join  dependencies and definition of 5NF. |
| 5 | Transaction Processing and Error Recovery | Concepts of transaction processing, ACID properties, Concurrency control, Serializability, Locking based protocols, Time stamp based protocol, Error recovery and logging, Undo, Redo, Undo-redo logging  and recovery methods. |

|  |  |  |
| --- | --- | --- |
| 6 | Data Storage and Indexes | File organizations, Primary, Secondary index structures, Hash-based indexing, Dynamic hashing techniques, Multi-level indexes, B trees,  B+ trees. |

1. **Course Objective:**
   1. Understand the role of a database management system in an organization.
   2. Understand basic database concepts, including the structure and operation of the relational data model.
   3. Construct simple and moderately advanced database queries using Structured Query Language (SQL).
   4. Understand and successfully apply logical database design principles, including E-R diagrams and database normalization.
   5. Design and implement a small database project using Microsoft Access.
   6. Understand the concept of a database transaction and related database facilities, including concurrency control, journaling, backup and recovery, and data object locking and protocols.
   7. Describe and discuss selected advanced database topics, such as distributed database systems and the data warehouse.
   8. Understand the role of the database administrator.

## Course Outcome:

|  |  |
| --- | --- |
| **CO #** | **Detail** |
| CO1 | Describe the fundamentals of relational database management systems |
| CO2 | Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL. |
| CO3 | Design ER-models to represent simple database application scenarios |
| CO4 | Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data. |
| CO5 | Improve the database design by normalization. |
| CO6 | Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.. |

1. **Text Book:**

Fundamentals of Database Systems By Elmsari & Navathe, Person Publication, 7th edition, 2016.

## Reference Books:

R1. Database System Concepts by Silberschatz,, Korth & Sudarshan, McGraw-Hill education, 6th edition, 2013.

R2**.** Database Management Systems By Ramakrishnan & Gehrke, McGraw-Hill education, 3rd edition, 2014.

R3. Fundamentals of Relational database Management Systems by Sumathi & Esakkirajan, Springer, 2007.

## Reference Site:

RS1. NPTEL - https://onlinecourses.nptel.ac.in/explorer

RS2. Tutorials Point - https://[www.tutorialspoint.com/dbms/index.htm](http://www.tutorialspoint.com/dbms/index.htm) RS3. Geeks for geeks - <http://www.geeksforgeeks.org/>

## Pre-requisites:

* Mathematics for Computer Science

## Course Lesson Plan:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Lecture No.** | **Unit** | **Topics** | **Day #** | **Refer to Chapter, See (Book)** |
| 1-5 | Introduction | General introduction to database systems | 1 | Ch 1 (T1)  Ch 1, 2 (T2) |
| Database- DBMS distinction, Approaches to building a database | 2 |
| Data models | 3 |
| Three-schema architecture of a database | 4 |
| Challenges in building a DBMS, Various components of a DBMS | 5 |
| 6-11 | ER Model | Conceptual data modeling – motivation | 6 | Ch 7 (T1)  Ch 3, 4 (T2)  Ch 2 (R2) |
| Entities, Entity sets, Various types of attributes | 7 |
| Relationships, Relationship types | 8 |
| Types of Entity sets, Participation Constraints | 9 |
| E/R diagram notation, Examples | 10 |
| Extended E/R Model, Examples | 11 |
| 12-20 | Relational Data Model | Concept of relations and its characteristics, Schema-instance  distinction | 12 | Ch 2, 3, 4, 5, 6 (T1)  Ch 5, 6, 7, 8, 9 (T2)  Ch 3,4,5 (R1)  Ch 2, 3, 4 (R2) |
| Integrity Constraints | 13 |
| Converting the database specification in E/R and extended E/R notation to  the relational schema | 14 |
| Relational algebra operators: Selection, Projection, Cross product | 15 |
| Types of Joins, Division/ | 16 |
| Tuple relation calculus | 17 |
| Domain relational calculus | 18 |
| SQL | 19 |
| SQL | 20 |
| 21-28 | Relational Database Design | Dependencies and Normal Forms | 21 | Ch 8 (T1)  Ch 14, 15 (T2)  Ch 19 (R1) |
| Importance of a good schema design, Problems encountered with bad schema designs | 22 |
| Motivation for normal forms, Dependency theory - functional  dependencies | 23 |
| Armstrong's axioms for FD's, Closure of a set of FD's, Minimal covers | 24 |
| 1NF, 2NF | 25 |
| 3NF and BCNF | 26 |
| Decompositions and desirable properties of them, Multi-valued dependencies and 4NF | 27 |
| Join dependencies and definition of 5NF | 28 |
| 29-35 | Transacti on Processin g and Error Recovery | Concepts of transaction processing | 29 | Ch 14, 15, 16 (T1)  Ch 20, 21, 22 (T2) |
| ACID properties | 30 |
| Concurrency control, Serializability | 31 |
| Locking based protocols, | 32 |
| Time stamp based protocol | 33 |
| Error recovery and logging | 34 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Lecture**  **No.** | **Unit** | **Topics** | **Day #** | **Refer to Chapter, See**  **(Book)** |
|  |  | Undo, Redo, Undo-redo logging and recovery methods | 35 |  |
| 36-40 | Data Storage and Indexes | File organizations | 36 | Ch 11 (T1)  Ch 16, 17 (T2) |
| Primary, Secondary index structures | 37 |
| Hash-based indexing | 38 |
| Multi-level indexes, B trees, B+ trees | 39 |
| Multi-level indexes, B trees, B+ trees | 40 |

1. **Evaluation Scheme:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ES**  **No.** | **Evaluation Component** | **Duration** | **Percentage of Evaluation** | **Date** | **Course Lecture No.** | | **Mode** |
| **From** | **To** |
| 1 | Mid-Semester Examination | 11/2 Hrs | 20 | TBD | 1 | 20 | Closed Book |
| 2 | Activity based Teaching and Learning | Through out semester | 30 | Through out semester | NA | NA | Open Book, Closed Book  and Presentation |
| 3 | End-Semester Examination | 3 Hrs | 50 | TBD | 1 | 40 | Closed Book |

Mid-semester question paper comprises of 6 questions and students are required to answer any four questions including question no 1, which is compulsory. Weightage for each question is 5. There will be 5 parts in question no 1.

End-semester question paper comprises of 8 questions and students are required to answer any six questions including question no 1, which is compulsory. Weightage for 1st question is 10 and 8 for others. There will be 10 parts in question no 1.

## Activity based Teaching and Learning:

Considering the guidelines circulated and after discussing with the faculty members, following activity based teaching and learning is proposed:

## Activity List

Component wise distributions of the activities are listed below.

|  |  |  |
| --- | --- | --- |
| **Problem Solving** | **Critical Thinking** | **Quiz** |
| 15 | 10 | 5 |

Considering the guidelines circulated and after discussing with the faculty members, following component wise description of each activity list is proposed:

## Problem solving (15 marks): Assignment

Assignments have to be solved in a group/individual. Faculties are free to give their own assignments and evaluation is to be done by respective assigned subject teacher. Subject teacher need to decide the number of groups and students for each group. Students are expected to write the solution in the paper and submit to the subject teacher.

## Critical thinking (10 marks): Mini-Project

Critical thinking process is related to demonstrating the mini-project and is the group wise activity. The group has to submit the source code and 2 pages report capturing design aspect of the project.

## Quiz (5 marks): Mini-Project

Two quizzes with easy, moderate and difficulty level will be conducted at the mid and end of semester. Faculties are free to give their own questions in the quiz. Evaluation is to be done by respective assigned subject teacher.

## Unit wise Activity List:

* Students are required to submit at least 3 out of 4 assignments.
* Students are required to submit the mini project.
* Students have to appear 2 quizzes.

1. **Course Materials:** Concerned teachers are requested to provide course materials to the students. The material consists of –

* Lecture Notes
* Class Work
* Home Work
* Supplementary Reading

1. **Activity Planning: S:** Starting class

## C: Class

|  |  |  |
| --- | --- | --- |
| **Sr #** | **Activity** | **Activity Planned Date** |
| 1 | Assignment 1 | S + 8 C |
| 2 | Assignment 2 | S + 15 C |
| 4 | Quiz 1 | S + 19 C |
| 5 | Assignment 3 | S + 27 C |
| 6 | Assignment 4 | S + 34 C |
| 9 | Quiz 2 | S + 35 C |
| 11 | Mini Project | S + 36 C |

1. **Parameters:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subject code** | **L** | **T** | **P** | **Total** | **Credit** |
| CS 2004 | 3 | 1 | 0 | 4 | 4 |

1. **Chamber Consultation hour:** To be announced in the class by the concerned teacher.
2. **Notices:** All teachers are requested to communicate every notice regarding the course to their students.