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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

**School of Computer Science**

**Dehradun**

**COURSE PLAN**

Programme : B. Tech (CSE) - Dept. of Virtualization (Graphics & Gaming)

Course : Advanced Database Management Systems

Course Code : CSEG2005

No. of credits : 4

Semester : III

Session : 2019-20 (Aug-Dec-2019)

Batch : 2018-22

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**Approved By**

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**COURSE PLAN**

1. **PREREQUISITE:**
   1. Data structures and algorithms
   2. Computer systems
   3. Sufficient programming experience
   4. Memory Architecture
2. **PROGRAM OUTCOMES (POs) and PROGRAM SPECIFIC OUTCOMES (PSOs):**

**B1. PROGRAM OUTCOMES (POs)**

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions:** 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.

**PO4: Conduct investigations of complex problems:** 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.

**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6: The engineer and society:** 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.

**PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication:** 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: Project management and finance:** 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: Life-long learning:** 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.

**B2. Program Specific Outcomes (PSOs)**

**PSO1:** Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques.

**PSO2:** Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms.

**PSO3** Apply the understanding of DevOps as cultural philosophies, practices, and tools that increase the ability to deliver applications and services at high velocity.

1. **Course Objective and Outcomes for Advanced Database Management Systems**

**Course Objectives**

1. Understand the architecture and functioning of database management systems as well as associated tools and techniques, principles of data modelling using entity relationship and develop a good database design and normalization techniques to normalize a database.
2. Understand the use of structured query language and its syntax, transactions, database recovery and techniques for query optimization.
3. Acquire a good understanding of database systems concepts and to be in a position to use and design databases for different applications.
4. Design the conceptual schemas of database applications using Enhanced Entity Relationship model (EER).
5. Understand the internal disk storage structures of the Database Management Systems.
6. Understand the transaction and concurrency mechanisms of the Database Management Systems.
7. Familiar with the contemporary database models like OO Databases, Distributed Databases etc.

**Course Outcomes**

**CO1.** Understand the terminology, features, classifications, and characteristics of database systems.

**CO2.** Analyze various modelling techniques including ER and EER to design a logical view of RDBMS.

**CO3.** Analyze various disk storage, Indexing and hashing techniques for data storage.

**CO4.** Formulate using relational algebra, relational calculus and SQL solutions to a broad range of query problems.

**CO5.** Demonstrate normalization theory and apply such knowledge to the normalization of a database.

**CO6.** Design and develop a basic commercial database design and its implementation including integrity constraints, transaction management and concurrent control algorithms.

**Table: Mapping of POs and PSOs v/s COs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO 12 | PSO 1 | PSO 2 | PSO  3 |
| CO1 | 3 | 1 | 1 | - | 1 | 3 | - | - | 1 | - | - | 2 | 1 | 3 | - |
| CO2 | 3 | 3 | 2 | - | 2 | 2 | - | - | 2 | - | - | 2 | 2 | 3 | - |
| CO3 | 3 | 3 | 2 | - | 3 | 2 | - | - | 1 | - | - | 2 | 2 | 3 | - |
| CO4 | 3 | 3 | 2 | - | 2 | 2 | - | - | 1 | - | - | 2 | 2 | 3 | - |
| CO5 | 3 | 3 | 1 | - | 2 | 2 | - | - | 1 | - | - | 2 | 2 | 3 | - |
| CO6 | 3 | 3 | 2 | - | 2 | 2 | - | - | 1 | - | - | 2 | 2 | 3 | 1 |

1=weakly mapped 2= moderately mapped 3=strongly mapped

**Table: Correlation of POs and PSOs v/s COs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Engineering Knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual or team work | Communication | Project management and finance | Life-long Learning | System and application programming | Software development and project management methodologies | Apply the understanding of DevOps as cultural philosophies, practices, and tools that increase the ability to deliver applications and services at high velocity |
| Course Code | Course Title | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO6 | PO 7 | PO8 | PO9 | PO 10 | PO 11 | PO12 | PSO1 | PSO2 | PSO3 (GG) |
| CSEG2005 | Advanced Database Management Systems | 3 | 3 | 2 | - | 2 | 2 | - | - | 1 | - | - | 2 | 2 | 3 | - |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

1. **COURSE OUTLINE**

|  |  |  |
| --- | --- | --- |
| **S. No** | **Unit** | **Contents** |
| 1. | Unit I | Overview Of Databases and Data Modelling |
| 2. | Unit II | Relational Algebra and Normalization |
| 3. | Unit III | DBMS Architecture, Query Processing and Optimization |
| 4. | Unit IV | Disk Storage, Basic File Structures, Hashing and Indexing |
| 5. | Unit V | Transaction Management, Concurrency Control and Recovery Techniques |
| 6. | Unit VI | OODB and Distributed Database |

1. **PEDAGOGY**
2. Class Test
3. Assignment
4. Quiz
5. Digital and analog Presentations
6. **COURSE COMPLETION PLAN**

|  |  |
| --- | --- |
| Total Class room sessions | 48 |
| Total Quizzes | 02 |
| Total Test | 02 |
| Total Assignment | 02 |

One Session =60 minutes

1. **EVALUATION & GRADING**

Students will be evaluated based on the following 3 stages.

Internal Assessment - 30%

Mid-semester Examination - 20%

End-semester Examination - 50%

**G1. INTERNAL ASSESSMENT: WEIGHTAGE – 30%**

Internal Assessment shall be done based on the following:

|  |  |  |
| --- | --- | --- |
| Sr. No. | Description | % of Weightage out of 30% |
| 1 | 2 Class Tests | 50% |
| 2 | 2 Quizzes | 25% |
| 3 | 2 Assignment | 25% |

**G2*. Internal Assessment Record Sheet (including Mid Term Examination marks)***

Sheet will be displayed online at the end of semester i.e. last week of regular classroom teaching.

**G3. CLASS TESTS/QUIZZES:**

Two Class Tests based on descriptive type theoretical & numerical questions and Two Quizzes based on objective type questions will be held; one class test and one quiz at least ten days before the Mid Term Examination and second class test and second quiz at least ten days before the End Term Examination. Those who do not appear in Viva-Voce and quiz examinations shall lose their marks.

*The marks obtained by the students will be displayed on LMS a week before the start of Mid Term and End Term Examinations respectively.*

**G4. ASSIGNMENTS:**

After completion of each unit or in the mid of the unit, there will be home assignments based on theory and numerical problems. Those who fail to submit the assignments by the due date shall lose their marks.

**G5. MID TERM EXAMINATION: WEIGHTAGE – 20%**

Mid-semester examination will cover approximately half of the entire course content and shall be of two hours duration. It will be a combination ofShort and Long theory Questions.

***Date of showing Mid Term Examination Answer Sheets: Within a week after completion of mid semester examination.***

**G6. END TERM EXAMINATION: WEIGHTAGE – 50%**

End Term Examination shall be Three Hours duration and shall be a combination of Short and Long theory/numerical Questions.

**G7. GRADING:**

The overall marks obtained at the end of the semester comprising all the above three mentioned shall be converted to a grade.

1. **COURSE DELIVERY PLAN**

|  |  |  |  |
| --- | --- | --- | --- |
| **Lecture No** | **Topics** | **Course Outcomes Addressed** | **Assessment** |
| **Unit 1: Overview Of Databases and Data Modelling** | | | |
| 1 | Database & Database users, characteristics and advantages of the database | CO1, CO2 | Assignment 1 based on unit 1 |
| 2 | Database systems, concepts and architecture, Data models, schemas & instances |
| 3 | Three-Schema architecture & data independence, database languages & interfaces |
| 4 | Centralized and Client/Server Architecture of DBMS, Classification of DBMS |
| 5 | ER Diagrams, EER Diagrams |
| 6 | Mapping of ER and EER Model to Relations, Codd’s Rule |
| 7 | Basics of SQL |
| **Unit 2: Relational Algebra and Normalization** | | | |
| 8 | Relational model Concepts, Relational model constraint & relational database schemas | CO4, CO5 | Quiz 1 based on unit 1 and unit 2 |
| 9 | Transactions, and dealing with constraint Violation, DBMS Keys |
| 10 | Relational Algebra, Unary relational operation, Binary relational operations and ,relational algebra operations from set Theory |
| 11 | Relational Algebra, Unary relational operation, Binary relational operations and ,relational algebra operations from set Theory |
| 12 | Relational Calculus; and implementation in SQL, Informal Design guideline for relational Schemas |
| 13 | Relational Calculus; and implementation in SQL, Informal Design guideline for relational Schemas |
| 14 | Functional Dependencies, Normal forms based on primary keys, (1NF, 2NF, 3NF & BCNF) |
| 15 | Functional Dependencies, Normal forms based on primary keys, (1NF, 2NF, 3NF & BCNF) |
| 16 | lossless join and dependency preserving decomposition |
| 17 | Multivalued dependencies (4NF, 5NF), domain key normal form. |
| 18 | Multivalued dependencies (4NF, 5NF), domain key normal form. |
| **Unit 3: DBMS Architecture, Query Processing and Optimization** | | | |
| 19 | DBMS Instance, DBMS Internal Memory Structure, Background Processes | CO4 | Class test based on unit 1, unit 2 and unit 3 |
| 20 | Data Types, Roles & Privileges |
| 21 | Introduction to Query Processing, Translating SQL Queries into Relational Algebra |
| 22 | Algorithms for External Sorting, Algorithms for SELECT and JOIN Operations |
| 23 | Algorithms for PROJECT and SET Operations |
| 24 | Implementing Aggregate Operations and Outer Joins |
| **Mid Semester Examination** | | | |
| **Unit 4: Disk Storage, Basic File Structures, Hashing and Indexing** | | | |
| 25 | Introduction, Secondary Storage Devices | CO3 | Assignment 2 Based on unit 4 |
| 26 | Buffering of Blocks and Placing File Records on Disk |
| 27 | Operations on Files, Heap Files, Sorted Files, Hashing Techniques |
| 28 | Parallelizing Disk Access using RAID Technology, Secondary Access Paths |
| 29 | Types of Single-Level Ordered Indexes, Multilevel Indexes |
| 30 | Dynamic Multilevel Indexes Using B-Trees and B+ Trees, Indexes on Multiple Keys |
| 31 | Dynamic Multilevel Indexes Using B-Trees and B+ Trees, Indexes on Multiple Keys |
| **Unit 5: Transaction Management, Concurrency Control and Recovery Techniques** | | | |
| 32 | Introduction to Transaction Processing, Transaction and System Concepts | CO6 | Quiz 2 Based on unit 4 and unit 5 |
| 33 | Desirable Properties of Transactions, Characterizing Schedules based on Recoverability |
| 34 | Characterizing Schedules based on Serializability |
| 35 | Introduction to Concurrency Control |
| 36 | Two Phase Locking Techniques |
| 37 | Concurrency Control on Timestamp Ordering |
| 38 | Validation Concurrency Control Techniques |
| 39 | Granularity of Data items and Multiple Granularity Locking |
| 40 | Recovery Concepts, Recovery Techniques Based on Deferred and Immediate Update |
| 41 | Shadow Paging |
| **Unit 6: OODB and Distributed Database** | | | |
| 42 | Overview of Object-Oriented Concepts, Object Model of ODMG | CO6 | Class test 2 Based on unit 4, unit 5 and unit 6 |
| 43 | Object Definition Language, Object Query Language |
| 44 | Object Database Conceptual Design, |
| 45 | Distributed Database Concepts |
| 46 | Data Fragmentation, Replication and Allocation Techniques for Distributed Design |
| 47 | Types of Distributed Database Systems, Query Processing in Distributed Databases |
| 48 | Overview of Concurrency Control and recovery techniques in Distributed Databases |

1. **SUGGESTED READINGS:**

**I1. TEXT BOOK:**

1. Fundamentals of database systems, 7th edition, by Remez Elmasri and Shamkant b. Navathe, Pearson education
2. Sql, Pl/Sql the programming language of Oracle, iii- edition, Ivan Bayross

**I2. REFERRENCE BOOKS:**

1. Database System Concepts by Avi Silberschatz,Henry F. Korth,S. Sudarshan
2. Introduction to Database systems by Bipin Desai
3. Database Management Systems by C.J Date
4. Database Management System by Ramakrishnan
5. **GUIDELINES**

***Cell Phones and other Electronic Communication Devices*:** Cell phones and other electronic communication devices (such as Blackberries/Laptops) are not permitted in classes during Tests or the Mid/Final Examination. Such devices MUST be turned off in the class room.

***E-Mail and online learning tool:*** Each student in the class should have an e-mail id and a pass word to access the LMS system regularly. Regularly, important information – Date of conducting class tests, guest lectures, via online learning tool. The best way to arrange meetings with us or ask specific questions is by email and prior appointment. All the assignments preferably should be uploaded on online learning tool. Various research papers/reference material will be mailed/uploaded on online learning platform time to time.

***Attendance:*** Students are required to have **minimum attendance of 75%** in each subject. Students with less than said percentage shall **NOT** be allowed to appear in the end semester examination.

***Passing criterion:*** Student has to total 35 marks in end semester examination and also in total marks.

1. **COURSE OUTCOME ASSESSMENT**

To assess the fulfilment of course outcomes two different approaches have been decided. Degree of fulfillment of course outcomes will be assessed in different ways through direct assessment and indirect assessment. In Direct Assessment, it is measured through quizzes, tests, assignment, Mid-term and/or End-term examinations. It is suggested that each examination is designed in such a way that it can address one or two outcomes (depending upon the course completion). Indirect assessment is done through the student survey which needs to be designed by the faculty (sample format is given below) and it shall be conducted towards the end of course completion. The evaluation of the achievement of the Course Outcomes shall be done by analyzing the inputs received through Direct and Indirect Assessments and then corrective actions suggested for further improvement.

|  |
| --- |
| NAME: |
| ENROLLMENT NO: |
| SAP ID: |
| COURSE: B. Tech. 3rd Semester |
| PROGRAM: CSE (GG) |

Please rate the following aspects of course outcomes of Advanced Database Management Systems

Use the scale 1-4\*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sr. No.** | **Course Outcome** | **1** | **2** | **3** | **4** |
| 1 | **CO1.** Understand the terminology, features, classifications, and characteristics of database systems. |  |  |  |  |
| 2 | **CO2.** Analyze various modelling techniques including ER and EER to design a logical view of RDBMS. |  |  |  |  |
| 3 | **CO3.** Analyze various disk storage, Indexing and hashing techniques for data storage. |  |  |  |  |
| 4 | **CO4.** Formulate using relational algebra, relational calculus and SQL solutions to a broad range of query problems. |  |  |  |  |
| 5 | **CO5.** Demonstrate normalization theory and apply such knowledge to the normalization of a database. |  |  |  |  |
| 6 | **CO6.** Design and develop a basic commercial database design and its implementation including integrity constraints, transaction management and concurrent control algorithms. |  |  |  |  |

3

Below Average

Good

1

**\***

Very Good

Average

4

2