Computer Science Department
cs.salemstate.edu

ITE 420 Database Administration **4 cr.**

Catalog description:

A database administrator (DBA) directs or performs all activities related to maintaining a successful database environment. This courses demonstrates the fundamental tasks and functions required of a DBA. The topics of this course include understanding the role of DBA, creating the database environment, application design, database change management, data availability, data integrity, database security, database backup and recovery, disaster planning, system and application performance techniques. While Oracle is the primary database management system utilized, the concepts and procedures presented in this course are typical for any database management system server. Four lecture hours per week.

Prerequisite: ITE 320

Course Narrative

This course is designed to teach students the architecture (logical and Physical) structure of the Oracle Database Management System. As each student is required to have a working knowledge of the Relational Database Model as well as SQL and PL/SQL programming skills, this course focuses on the administration of a DBMS including creation, management, maintenance, and operation of a database management system.

In this course, students will develop an understanding of the internal structures and organization of an Oracle database. The course will present a framework approach to the planning, building, tuning, and monitoring of an Oracle11g database. Students will create their own Oracle database, including tablespaces, user accounts, views, indexes, and other objects necessary to support an application. They will use this database for the duration of the class and complete a number of exercises using this database.

The course will have both lab and lecture. The student will be required to do assigned readings from the text and handouts as well as scheduled team labs to reinforce the material covered in class. Scheduled tests will be used to assess the progress of the student toward achievement of the course objectives.

Goals:

G1: This course will enable students to be able to identify the role of database administrator;
G2: This course discusses the database standards and procedures that are required to provide best database management system;
G3: This course will enable students to analyze the importance of data availability, data integrity, database security, and database backup and recovery;
G4: This course will enable students to identify the components involved in creating the database

environment;

G5: This course will enable students to identify system, application and database performance techniques.

Course Objectives:

Upon successful completion of the course, a student will have demonstrated the ability to:

O1: install a database management system;
O2: update database management system versions and releases;
O3: define database transactions and execute them;
O4: demonstrate the ability to perform batch processing;
O5: identify basic database security and perform grant, revoke privilege on the database for users
O6: demonstrate the ability to perform backup and recovery of database;

Program Objective / Course Objective matrix (For ABET Accreditation Purposes)

(The following Matrix maps the Program Objectives for Information Technology Program outlined by Accreditation Board of Engineering Technology (ABET) with the Course Objectives. The check marks below the course objective represent that those course objectives accomplish specific program objectives set forth by ABET.)

Program Objective	O1	O2	O3	O4	O5	O6
PO-A: An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline.	✓			✓	✓	
PO-B: An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.		✓	✓		✓	✓
PO-C: An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.	✓	✓	✓	✓	✓	✓
***PO-D:** An ability to function effectively on teams to accomplish a common goal.						
***PO-E:** An understanding of professional, ethical, legal, security and social issues and responsibilities.						
***PO-F:** An ability to communicate effectively with a range of audiences.						
***PO-G:** An ability to analyze the local and global impact of computing on individuals, organizations, and society.						
***PO-H:** Recognition of the need for and an ability to engage in continuing professional development.						
PO-I: An ability to use current techniques, skills, and tools necessary for computing practice.	✓	✓	✓	✓	✓	✓
PO-J: An ability to use and apply current technical concepts and practices in the core information technologies.			✓	✓		

Program Objective	O1	O2	O3	O4	O5	O6
PO-K: An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems.			✓	✓	✓	
***PO-L:** An ability to effectively integrate IT-based solutions into the user environment.						
***PO-M:** An understanding of best practices and standards and their application.						
***PO-N:** An ability to assist in the creation of an effective project plan.						

Course Topics:

The column on the right hand side represents the Body of Knowledge and number of hours (in parenthesis) set forth by ABET accreditation board for accomplishing minimum required hours assigned for different categories. More information on this body of knowledge can be found in Appendix A "The IT Body of Knowledge" on Page 68 of the following document.
http://www.acm.org//education/curricula/IT2008%20Curriculum.pdf

- **What is DBA?** **IM1(3)**
  - Why learn Database Administration?
  - Database, Data, and System Administration
  - DBA Tasks
  - Types of DBAs

- **Creating the Database Environment** **IM3(6)**
  - Defining the organizations DBMS Strategy
  - Installing the DBMS
  - Upgrading DBMS Versions and Releases
  - Database Standards and Procedures

- **Application Design** **IM2(3)**
  - Database Application Development and SQL
  - Defining Transactions
  - Locking
  - Batch Processing

- **Database Change Management** **IM5(2)**
  - Change Management Requirements
  - Types of Changes
  - Impact of Change on Database Structures

- **Data Availability** **IM5(2)**
  - Defining Availability

- Cost of Downtime
- Availability Problems
- Ensuring Availability

- **Data Integrity** **IM5(2)**
  - Types of Integrity
  - Database Structure Integrity
  - Semantic Data Integrity

- **Database Security** **NET4(3)**
  - Data Breaches
  - Database Security Basics
  - Granting and Revoking Authority
  - Authorization Roles and Groups
  - Other Database Security Mechanisms
  - Encryption
  - SQL Injection
  - Auditing
  - External Security
  - DBMS Fixpacks and Maintenance

- **Database Backup and Recovery** **SA3(5)**
  - The Importance of Backup and Recovery
  - Preparing for problems
  - Backup
    - Full versus Incremental Backups
    - Concurrent Access Issues
    - Backup Consistency
    - Log Archiving and backup
    - Determining your Backup Schedule
    - Designing the DBMS Environment for Recovery
  - Recovery
    - Determining Recovery Options
    - Types of Recovery
    - Testing your Recovery plan
  - Alternatives to Backup and Recovery

- **Disaster Planning** **IM1 (2)**
  - The need for planning
  - General Disaster Recovery Guidelines
  - Backing up the database for disaster recovery
  - Disaster Prevention

- **DBA Tools** **IM4(2),IM5(3)**
  - Types and Benefits of DBA Tools
  - Data Modeling and Design
  - Database change management

- Table Editors
- Backup and recovery
- Programming and Development Tools

- **Performance Management** **IM3(3)**
  - Defining performance
    - A basic Database performance road map
  - Monitoring versus Management
    - Reactive versus proactive
    - Preproduction performance estimation
    - Historical Trending
  - Service-level management
  - Types of performance tuning
    - System Tuning
    - Database Tuning
    - Application Tuning
  - Performance Tuning Tools
  - DBMS Performance Basics

- **System Performance Techniques** **IM3(2)**
  - The Larger Environment
    - Interaction with the Operating System
    - Allied Agents
    - Hardware Configuration
    - Components of the DBMS
  - DBMS Installation and Configuration Issues
    - Types of configuration
    - Memory Usage
    - Data Cache Details
    - "Open" Database Objects
    - Database Logs
    - Locking and contention
    - The system catalog
    - Other configuration option
  - System Monitoring

- **Application Performance Techniques** **IM5(2)**
  - Designing Applications for Relational Access
  - Relational Optimization
    - CPU and I/O Costs
    - Database Statistics
    - Query Analysis
    - Joins
    - Access Path Choices
  - Additional Optimization Considerations
    - View Access
    - Query Rewrite
    - Rule-Based Optimization

- Reviewing Access Paths
    - Forcing Access Paths
- SQL Coding and Turning for Efficiency
    - A Dozen SQL Rules of Thumb
    - Additional SQL Tuning Tips
    - Identifying Poorly Performing SQL

- **Database Performance Techniques** **IM3(2)**
    - Techniques for Optimizing Databases
        - Partitioning
        - Raw Partition versus File System
        - Indexing
        - Denormalization
        - Clustering
        - Interleaving Data
        - Free Space
        - Compression
        - File Placement and Allocation
        - Page Size (Block Size)
    - Database Reorganization
        - Determining when to reorganize
        - Automation

- **DBA Rules of Thumb** **IM1(2)**
    - Write Down Everything
    - Keep Everything
    - Automate!
    - Share your knowledge
    - Analyze, Simplify, and Focus
    - Don't Panic
    - Measure Twice

Student Experiences:

Laboratory/Project exercises

Weekly labs consist of hands-on exercises that include but not limited to below list:

- Using Administrative Tools
- Preparing to Create a Database and Database Startup
- Generating the Production Database
- Administering your Database
- Administering the Control Files and Redo Logs
- Managing Tablespaces and Data Files
- Storage Structures
- Tables, Indexes and Constraints
- Rollback Segments
- Managing Users
- Monitoring the Database

- Tuning the Database
- Oracle 8i/9i/10g Backup and Recovery

Projects
The outcomes of several labs will be combined into the starting point for two or more extensive projects, the lab-work serving as scaffolding for building up solutions to relatively complex problems. All lab/project reports must conform to guidelines announced in class. Projects will be assessed and graded against the Project Implementation rubric.

Quizzes, Tests and Examinations
There will be four quizzes (each covering a major topic), a midterm, and a cumulative final. Quizzes and exams will include multiple choice and problem solving tasks.

Final Grade
Final grade will be determined on the basis of the following approximate weights:

Grading Categories	Weights (%)
Homework Assignments	20
Lab Projects	30
Quizzes	10
Midterm exam	20
Final exam	20
Total	100

Student Experiences by Course Outcome (Objective) matrix:

	Lab Projects	Quizzes	Midterm exam	Final Exam
CO1	✓	✓	✓	✓
CO2	✓	✓	✓	✓
CO3	✓	✓	✓	✓
CO4	✓	✓		
CO5	✓			
CO6	✓	✓	✓	✓

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