

## DSO 435 – Enterprise Data Architecture

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<b>Time:</b>	Tuesday and Thursday 2:00 PM – 3:50 PM
<b>Place:</b>	JFF LL103
<b>Professor:</b>	Douglas Shook, Ph.D.
<b>Office hours:</b>	Tu/Th 4:00 PM – 5:00 PM at JFF, and by appointment at CAL 3 <sup>rd</sup> floor
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<b>Blackboard:</b>	<a href="https://blackboard.usc.edu">https://blackboard.usc.edu</a>

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### Overview of the Course:

Other than its human resources, data arguably is the single most important asset an organization possesses. Enterprise-wide management of data architecture is a core business requirement for any successful organization today. Complete, real-time, high-integrity data is necessary for most business operations including Data Analytics (DA), Business Intelligence (BI), tailoring customer experiences with immediate, personalized data, contextualization with “Big Data,” and synchronizing and integrating legacy data with Cloud/SaaS applications, etc.

This course is motivated by a recognition of the importance of enterprise data architectures for understanding, designing, and building effective information technology for today's business organizations.

The objective of this course is to provide the prospective business or IT professional with fundamental concepts and skills in data modeling (conceptual, logical and physical), as well as in designing, building and managing the data layer to support business applications.

In addition to data modeling, considerable proficiency with Structured Query Language (SQL) will be obtained. Although object-oriented, and other database approaches will be discussed, the course focuses primarily on the use of state-of-the-art relational and object-relational databases. Oracle will be used as the primary pedagogical software in class and for required assignments.

Upon successful completion of this course, the prospective business or IT professional will be able to:

1. Design, build, and implement enterprise-grade data-layer architectures using Oracle 12c (this is your semester project).
2. Become highly proficient in creating high-integrity data models including conceptual, logical, and physical data models.
3. Perform data definitions (DDLs) and data manipulations (DMLs) using Structured Query Language (SQL).
4. Create Entity Relationship models, normalize those models, and translate those models into high-integrity [physical data models
5. Perform physical database optimization using transaction pattern and volume analyses.

**Prerequisites:** None

### Readings/Materials:

- Hoffer, J., Topi, H & Ramesh, V. (2014). *Essentials of Database Management*. Pearson ISBN: 9780133405682 suggest using the digital version – *on reserve in Crocker Library (three-hour checkout)*
- Bryla, B. & Loney, K. (2014). *Oracle 12c - The Complete Reference*, Osborne Oracle Press ISBN: 978-0-07-180174-4 *on reserve in Crocker Library (three-hour checkout) and PDF available on Blackboard (Optional)*
- Additional articles/handouts distributed in class.

## Course Details

### Grading:

Class Participation, In-Class Problem Solutions	10%
In-Class Team Exercises	10%
Oracle/SQL Programming Assignments	20%
Term Project	30%
In-Class Workshops (10% each)	30%

*(Extraordinary work in any of the above components will be rewarded accordingly with "grade overflow" into the other components. As per the 2019-2020 grading guidelines established by the Marshall School of Business, the average grade in this course will be 3.3.)*

### Class Participation:

Class participation will be based upon class attendance, involvement in class discussions and responses to questions asked in class. Additionally, problems from the Hoffer text labeled "Problems and Exercises" will be assigned. Class participants will be chosen randomly to present their solutions on the board for class analysis and discussion. (Individual work)

### Oracle/SQL Problems:

Two hands-on programming assignments will be done using Oracle. You will turn in the computer-generated output from your work. (Individual work)

### Workshops:

There will be three in-class workshops where you will perform data modeling (conceptual, logical, physical), as well as some SQL (DDL, DML, etc.). There will be no exams in this class. (Individual work)

### Project:

The term project will be the "cap stone" of the semester and requires the design and the implementation of this database using Oracle. The project will apply most of the issues/concepts covered during the semester and will enable you to obtain first-hand experience in designing and implementing a database from start to finish at an actual organizational site. It will be your responsibility to find a suitable project.

In the past, students have done projects in the organization where they worked, for some department in the university, local retailers, businesses they frequent, churches, social organizations, governmental agencies, or for their friends' or relatives' businesses. I would encourage you to develop an application for a not-for-profit, or similar organization, which may be able to afford to undertake such a project for a fee. The term project will result in a coded application and a high quality written report. The project will be undertaken in the small teams (generally between two and four members) with a minimum of three to five entities per member. Additional details regarding project requirements will be provided later. (Group work)

### Class Administrivia:

Unfortunately, a certain amount of administrivia, or housekeeping, is required for any course. Although I dislike including this section in the syllabus, it is only fair to make the course expectations clearly known at the outset of the class (hopefully there will be no surprises down the road). Following are the "rules" and expectations of the class:

- I assume you will attend all class meetings. If you must miss a class, please inform me beforehand. There will be no "make-ups" for missed work due to un-excused absences (this includes workshops).
- You will be expected to have prepared for each class by reading the assigned chapters and handouts. If you do not keep up with the readings, you will neither enjoy, nor benefit from the class.
- Typically I will use a randomized class list to call upon students to present their solutions to the assigned "Problems and Exercises" at the end of each chapter.

## Statement on Academic Conduct, Support Systems, Disabilities & Recording

### Academic Conduct:

**Plagiarism** – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” <https://policy.usc.edu/scampus-part-b/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

### Support Systems:

**Student Counseling Services (SCS)** - (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. <https://engemannshc.usc.edu/counseling/>

**National Suicide Prevention Lifeline** - 1-800-273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org>

**Relationship & Sexual Violence Prevention Services (RSVP)** - (213) 740-4900 - 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. <https://engemannshc.usc.edu/rsvp/>

**Sexual Assault Resource Center**

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: <http://sarc.usc.edu/>

**Office of Equity and Diversity (OED)/Title IX compliance** – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class. <https://equity.usc.edu/>

**Bias Assessment Response and Support**

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. <https://studentaffairs.usc.edu/bias-assessment-response-support/>

**Student Support & Advocacy** – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://studentaffairs.usc.edu/ssa/>

**Diversity at USC**

Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students. <https://diversity.usc.edu/>

### Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

### Classroom Recording

Various portions of this class may be captured/recorded for subsequent use by the students. The links to the recordings will be placed in Blackboard and only the students in this class should have access to them. Please note that your voice and or image may be recorded in the process.

## Course Schedule – Version 1.1



Date	Topic/Activities	Reading/Questions/Videos	Project Deliverables
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### Module 1 - Introduction to the Database Environment

Aug. 27	Course Overview & PE Introduction Get acquainted with your classmates	none / none	
Aug. 29	Database Environment & Development Introduction to Marshall Computer Accounts	Chap. 1 / none Video: DB Environment	Team Composition

### Module 2 – Basic Conceptual Data Modeling & Structured Query Language (SQL)

Sep. 3	Conceptual Data Modeling/ERD's I <i>Lab: Introduction ERD's drawing tools</i>	Chap. 2 / 7, 10, 17a-d	Client Site Selected
Sep. 5	Conceptual Data Modeling/ERD's II	(same as previous session)	
Sep. 10	Structured Query Language (SQL) I <i>Lab: Introduction to Oracle</i>	Chap. 6 & handout / 4a, 4b, 4c, 7a, 7b, 8a, 8b, 8c Video: Using SQL Developer Video: Git version control/setup	
Sep. 12	Conceptual Data Modeling/ERD's III	Chap. 2 / 7, 10, 17a-d	Business Function vs Entity Matrix
Sep. 17	Structured Query Language (SQL) II Team: SQL Activity	Chap. 6 & handout / 4a, 4b, 4c, 7a, 7b, 8a, 8b, 8c	
Sep. 19	Conceptual Data Modeling/ERD's IV	Chap. 2 / 7, 10, 17a-d	User Views from Client
Sep. 24	Structured Query Language (SQL) III Team: SQL Activity	Chap. 6 & handout / 4a, 4b, 4c, 7a, 7b, 8a, 8b, 8c	
Sep. 26	Conceptual Data Modeling/ERD's V Team: Modeling Activity	Chap. 2 / 7, 10, 17a-d	
Oct. 1	Enhanced Conceptual Data Modeling/ERD's I	Chap. 3 / 2a-c, 6, 7, 8	
<b>Oct. 3</b>	<b>First Hands-on Workshop</b>	none / none	
Oct. 8	First Workshop – Discussion & Analysis	none / none	

### Module 3 - Enhanced Conceptual Data Modeling & Structured Query Language (SQL)

Oct. 10	Advanced Structured Query Language (SQL) I Team: SQL Activity	Chap. 7 & handout / 1a, 1b, 2, 3, 4a, 5	
Oct. 15	Advanced Structured Query Language (SQL) II	(same as previous session)	ERD's for each user view
<b>Oct. 17</b>	<b>Fall Break</b>	none / none	
Oct. 22	Enhanced Conceptual Data Modeling II Team: Modeling Activity	Chap. 3 / 2a-c, 6, 7, 8	CDM

## Course Schedule – Version 1.1

Date	Topic/Activities	Readings/Questions/Videos	Project Deliverables
<b>Module 4 - Logical Database Design</b>			
Oct. 24	Logical Design and the Relational Model I	Chap. 4 / 1a-f, 2a-d, 3a-d	
Oct. 29	Logical Design and the Relational Model II Team: Modeling Activity	(same as previous session)	
<b>Oct. 31</b>	<b>Second Hands-on Workshop</b>	none / none	
<b>Nov. 1</b>	<b>Friday – Project consult with professor</b>	Professor provides in-depth, individual hands-on consulting assistance for your team project.	Bring all current project deliverables for review and assistance
<b>Nov. 2</b>	<b>Saturday – Project consult with professor</b>		
Nov. 5	Second Workshop Solutions, Discussion, Analysis	none / none	
<b>Module 5 - Physical Database Design</b>			
Nov. 7	Physical Design I	Chap. 5 / 1a, 1b	
Nov. 12	Physical Design II	(same as previous session)	
Nov. 14	Physical Database Optimization I Team: DB Performance Activity	(same as previous session)	
Nov. 19	Physical Database Optimization II	(same as previous session)	
Nov. 21	Physical Design & PL/SQL Team: PL/SQL Activity	PL/SQL handout	
<b>Nov. 26</b>	<b>Third Hands-on Workshop</b>	none / none	
<b>Nov. 28</b>	<b>Thanksgiving Break (no class)</b>	none / none	
<b>Module 6 - The "Wrap"</b>			
Dec. 2	Third Workshop Solutions, Discussion, Analysis	none / none	
<b>Dec. 5</b>	<b>Course Coalescence</b> <i>Tying it all together:</i> PE Presentation, Visualization Demo, Triggers & Stored Procedures, Class Evaluations	none / none	Transaction Analysis Forms
<b>Dec. 12</b>	<b>Projects due @CAL 330 from noon- 5:00 PM</b>	none / none	<b>Entire Project, printed and bound + USB containing all code and output</b>

## Components of the Database Design Project Report

### 1. Introduction

- a. Cover page
- b. Table of Contents
- c. Executive Summary

### 2. Planning for the Database - Please see handout "Practical Database Development" for detailed instructions on

- a. Business Function-to-Data Entity Matrix (page 9)

### 3. Conceptual Design

- a. Entity Relationship Diagrams (ERDs) for each user view. You also must attach the original "hardcopy" of the user view for comparison - please make it clear which ERD is for which user view.
- b. Some annotation/description for each user view is expected.
- c. Create a conceptual data model (CDM) by integrating all the individual user views into one ERD
- d. Business Rules/Constraints
  - i. Domain Definitions (create domain classes and refer individual attributes to them - page 128)
  - ii. Other business rules, restrictions, constraints and requirements for the database

### 4. Logical Design with the Relational Model

- a. Transform the conceptual data model into a set of Third Normal Form (3NF) relations indicating all primary and foreign keys, making note of any changes from the CDM due to normalization.

### 5. Physical Design and Implementation with the Relational Model

- a. Functionally decompose/expand your Business Function-to-Data Entity Matrix into a Process versus Entity Matrix using the Excel spreadsheet provided on Blackboard.
- b. Four separate Transaction Analysis Forms (TAFs) of key processes (see lecture handout) with at least two showing "creates."
- c. Composite Usage Map - combine TAFs with remaining usage and volume (see lecture handouts)
- d. List of all DDL statements necessary to create the physical model, making note of any changes from the logical model due to physical design/performance considerations.
- e. List contents of all populated tables/relations to show sample data (if output wraps on the page, please format it so it is readable).
- f. List six sample queries/views and the results of their executions (show the query statements/code and the output they generated). This is a good opportunity to display your SQL skills.
- g. Summary discussion of your physical design (e.g., index creations, clustering, responses to table volumes and access patterns, denormalizations, data distribution, table partitioning, triggers, stored procedures, security issues, physical implementation of the constraints, etc.). This portion of the report "implements" your project, please be rigorous/thorough here.

### 6. Summary and Conclusion

- a. Discuss difficulties encountered, how you solved problems, what you like most/least about your database and what you learned (a thorough description will be appreciated here).

**Please note:** In addition to the printed report, you must submit files (i.e., a disk or USB drive) containing all SQL code and output for your database tables, views, queries, etc. The report must be page numbered; the entries in the table of contents should appear as headings in the appropriate report sections. It should be well written in a "normal form" for business reports. As always, the report must have sufficient annotation (text) to explain why each diagram or page is in the report and what it is telling the reader. If you have questions regarding report format, please see me as I have samples from previous semesters.

**Please start this project early as possible; it will take longer to complete than you think.**