Example 3:

An in-major course that meets Core Requirement 4: Conducting Formal and Quantitative Reasoning (NCFQ) and Core Requirement 6: Analyzing and Using Data (NCAD). Core Requirement 6 is straightforward based on the course description, and thus minimal explanation is necessary. Core Requirement 4 requires an explanation, which is given.

Course Title: CS 3200 Database Design

Course Description from Course Catalog: Studies the design of a database for use in a relational database management system. The entity-relationship model and normalization are used in problems. Relational algebra and then the SQL (structured query language) are presented. Advanced topics include triggers, stored procedures, indexing, elementary query optimization, and fundamentals of concurrency and recovery. Students implement a database schema and short application programs on one or more commercial relational database management systems. Prereq. CS 1500 or CS 2510.

Brief description of how Course will provide opportunities to achieve the Learning Goals of Core Requirement 6: Analyzing and Using Data (NCAD). By the end of the course, students should be able to:

- **Learning Goal 1.** Describe how data may be acquired, stored, transmitted, and processed.
- **Learning Goal 2.** Analyze at least one important type of data and summarize the results of an analysis in ways that provide insight.
- **Learning Goal 3.** Use mathematical methods and/or computational tools to perform analysis.
- **Learning Goal 4.** Evaluate and critique choices made in selection, analysis, and presentation of data.

Discussion:
The focus of student effort in Database Design is 100% in the zone of data and all 4 Learning Objectives are emphasized throughout the course.

Brief description of how Course will provide opportunities to achieve the Learning Goals of Core Requirement 4: Conducting Formal and Quantitative Reasoning (NCFQ). By the end of the course, students should be able to:

- **Learning Goal 1.** Recognize when examination of a phenomenon or situation can benefit from problem solving techniques and analyses that use formal reasoning.
- **Learning Goal 2.** Use their expertise in some applications of formal reasoning and know when to call upon domain experts when a problem is beyond their personal expertise.
- **Learning Goal 3.** Generate artifacts that require formal reasoning and planning. These artifacts might include logical proofs, mathematical computations, software, simulations, problem solutions, or plans/analyses in a variety of disciplines that require a formal, systematic component.

Discussion:
The entity-relationship model is a formal model that permits the database designer to guarantee that no item of data will be duplicated in multiple cells of the database. Prior to the theoretical work on this model, many databases had the flaw that the same item would occur in several different cells so that an update to the item needed to be done in multiple places. This led to serious bugs when a data item was not properly updated. Understanding the entity-relationship model and its application to building a clean (normalized) database is a central theme of the course. Students must apply this formal theory over and over to properly design databases.