A. **TITLE:** Reinforced Concrete Design

B. **COURSE NUMBER:** CONS 304

C. **CREDIT HOURS:** 3

D. **WRITING INTENSIVE COURSE:** No

E. **COURSE LENGTH:** 15 Weeks

F. **SEMESTER(S) OFFERED:** Spring

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**
   2 lecture hours and one 2-hour recitation per week

H. **CATALOG DESCRIPTION:**
   In this course, the fundamentals of cast-in-place reinforced concrete design by the strength design method are introduced. Students design slabs, beams, girders, columns and footings in accordance with current version of American Concrete Institute Code 318. Computations are done by manual methods and spreadsheets. Students are introduced to design software. A design of elements of a small multi-story commercial building is incorporated into the class.

I. **PRE-REQUISITES/CO-COURSES:**
   a. Pre-requisites: CONS 336 (Structural Analysis) and CONS 280 (Civil Engineering Materials)

J. **GOALS (STUDENT LEARNING OUTCOMES):**
   By the end of this course, the student will be able to:

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<th>Course Objective</th>
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   | a) Analyze and design a reinforced concrete slab | 2. Critical Thinking  
   3. Professional Competence |
   | b) Analyze and design reinforced concrete beam (rectangular and tee-beam) | 2. Critical Thinking  
   3. Professional Competence |
   | c) Analyze and design a reinforced concrete girder | 3. Professional Competence  
   2. Critical Thinking |
   | d) Detail shear reinforcement for beams | 3. Professional Competence |
   | e) Detail splices and anchorages for reinforcement | 3. Professional Competence |
   | f) Analyze and design a reinforced concrete column | 2. Critical Thinking  
   3. Professional Competence |
   | g) Analyze and design a reinforced concrete footing | 2. Critical Thinking  
   3. Professional Competence |
K. **TEXTS:**

L. **REFERENCES:**
-- (2014) 318-14\(^1\): *Building Code Requirements for Structural Concrete and Commentary*. American Concrete Institute.

M. **EQUIPMENT:** Technology enhanced classroom

N. **GRADING METHOD:** A-F

O. **MEASUREMENT CRITERIA/METHODS:**
- Exams
- Quizzes
- Design Project(s)
- Homework

P. **DETAILED COURSE OUTLINE:**

I. **Introduction**
   A. Concrete and Reinforced Concrete as a material
   B. Advantages and Disadvantages of Structural Concrete
   C. ACI Code
   D. Reinf orcing Steel
   E. Concrete Mix Materials
   F. Dead and Live Loads

II. **Fundamental Principles of Bending**
   A. Behavior of a concrete beam in flexure
   B. Analysis of unreinforced beam by the flexure formula
   C. The internal couple method of analysis
   D. The strength design method for composite material

III. **Analysis and Design of Rectangular Reinforced Concrete Beams**
   A. Balanced, Over-reinforced, and Under-reinforced Beams
   B. Criteria for a tension controlled section
   C. Detailing requirements
   D. Load Factors
   E. Strength reduction factors and the maximum practical moment
   F. Rectangular Beam Analysis for Moment (Tension Reinforcement only)
   G. Rectangular Beam Design for Moment (Tension Reinforcement only)

IV. **Slabs**
   A. Slab nomenclature
   B. ACI Criteria for one way slabs

\(^1\) Or the year of the code that is in force when the course is implemented
C. Slab analysis
D. Slab design
E. Design of slabs on grade

V. Tee Beams
A. Tee Beam Analysis for Moment (Tension Reinforcement only)
B. Tee Beam Design for Moment (Tension Reinforcement only)
C. Design of compression steel

VI. Girder Design
A. Introduction
B. Calculation of shears and bending moments
C. Girder design

VII. Design of Shear Reinforcement in Beams
A. Introduction
B. Analysis of beams with no shear reinforcement
C. ACI Code requirements for shear steel
D. Shear Reinforcement Design Procedure
E. Design for torsion

VIII. Development Length - Introduction
A. Development Length - Tension Bars
B. Development Length - Standard Hooks in Tension
C. Development of Web Reinforcement
D. Splices
E. Cutoff of tension bars
F. Design of additional shear reinforcing in zones where tension bars are terminated

IX. Column Design
A. Introduction
B. Strength of Reinforced Concrete Columns - Small Eccentricity
C. Code Requirements Concerning Column Details
D. Analysis of Short Columns - Small Eccentricity
E. Design of Short Columns - Small Eccentricity
F. Eccentrically loaded columns

X. Footings
A. Introduction
B. Design of Square Reinforced Concrete Footings

Q. LABORATORY OUTLINE: NA