

University of Texas at Arlington
Department of Civil Engineering
AREN 4347 (001), CE 4347 (001): Reinforced Concrete Design
Spring, 2018

Catalog Data	CE 4347: Reinforced Concrete Design
Credits	3
Catalog Description (2017-2018)	An analysis, design and synthesis course for concrete structures, emphasizing strength design method. Topics include strength and serviceability requirements, design of one way slabs, rectangular beams, flanged sections and columns, for strength, shear, bond, bearing, and serviceability. Building codes, American Concrete Institute (ACI) specifications, material specifications, test methods, and recommended practice documents are involved.
Prerequisites	Grade of C or better in CE 3341 Structural Analysis (or an equivalent course). <i>The prerequisites will not be waived.</i>
Class Schedule	Lecture: T Th: 11:00 AM – 12:20 PM, Room 106 NH GTA help sessions: TBD
Instructor	Nur Yazdani, Ph.D., P.E., CE Professor and Former Chairman Office: 430 NH Office hours: M W: 2 PM – 4 PM I am also usually available in my office at other times, except before class periods. Alternately, you may schedule an appointment by phone or e-mail. Phone: (817) 272-0676 (Office) FAX: (817) 272-0371 E-mail: Yazdani@uta.edu
Teaching Assistant	U. M. Towfiqul Quadir, Graduate Ph.D. Teaching Assistant Office: Room 265 ELB Office hours: TBD Phone: 817-272-5646 E-mail: upalmohammadtowfiqulquadir@mavs.uta.edu
Course Materials	Optional Material (highly recommended): <ul style="list-style-type: none"> • <i>Design of Reinforced Concrete, 10th Edition, By Jack C. McCormac and Russell H. Brown, Wiley, ISBN: 978-1-118-87910-8.</i> • <i>Building Code Requirements for Structural Concrete, ACI 318-14, American Concrete Institute, Farmington Hills, MI, 2014.</i> • Dr. Yazdani lecture notes: available on Blackboard (http://www.uta.edu/blackboard/) Additional Optional Reference Material: <ul style="list-style-type: none"> • <i>Theory and Problems of Reinforced Concrete Design, by N. J. Everard, Schaum's Outline Series, McGraw-Hill Book Company.</i> This is a classic problem solving reference with numerous detailed worked out examples.

	<ul style="list-style-type: none"> • <i>Notes on ACI 318-14 Code for Concrete Design</i>, by the Portland Cement Association (PCA), Chicago, IL. This fine reference demonstrates many of the latest ACI 318 Code specification applications through explanations and examples. It contains many user-friendly design aids. A copy will be held as a reference in the Engineering Library. <p>Online Resources: A variety of on-line resources are available for the enhancement of your concrete design learning experience. There are many others. Please feel free to explore.</p> <p>www.cement.org www.pci.org www.concrete.org.uk www.concrete.org www.crsi.org</p>				
Computer Accounts	<ul style="list-style-type: none"> • Class e-mail will be sent to your UT Arlington account through the Blackboard course web site and also your MyMav account. If you use another primary e-mail account, you need to regularly check your UT Arlington e-mail for important information. • Lecture notes, this syllabus, assignments, assignment solutions, term project details, grades, etc. will be available on Blackboard (http://www.uta.edu/blackboard/) 				
Course Rationale	<p>In your previous courses, you have acquired knowledge in various areas such as mechanics (finding reactions, centroids and moments of inertias), strength of materials (finding stresses and strains in structures), and structural analysis (finding reactions, moments, shears and deflections). The previous courses laid the groundwork for your transformation into a structural/concrete designer. This course will build upon your knowledge from the previous courses, and will provide you with the skills needed to analyze and design real life basic concrete structural elements such as slabs, beams, and columns. Reinforced Concrete is one of the most widely used materials in modern buildings, bridges, highways, tanks, walls, dams, etc. Concrete is the most consumed material in the modern society, besides water. The strength, versatility, adaptability, durability, appearance and cost of modern concrete are unparalleled. This course will enable you to become familiar with the latest specifications, methods and software for concrete design. The course instruction will be heavily practice and technology oriented, with broad emphasis on practical applications and methodology. Material you learn in this course is critical to your becoming a successful and valued concrete engineer in today's highly competitive marketplace.</p>				
Student Outcomes	<p>At the end of this course, you should be able to accomplish the student outcomes shown in the following (http://www.uta.edu/ce/abet-accreditation.php). The goal of the course is to provide graduating seniors with a thorough background in the theory and practice of basic reinforced concrete design. Towards this end, the following student outcomes will be achieved:</p> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;"><u>Student Outcomes</u></th> <th style="text-align: right;"><u>Extent of Coverage*</u></th> </tr> </thead> <tbody> <tr> <td>(a) An ability to apply knowledge of mathematics, science, and engineering</td> <td style="text-align: right;">C₁</td> </tr> </tbody> </table>	<u>Student Outcomes</u>	<u>Extent of Coverage*</u>	(a) An ability to apply knowledge of mathematics, science, and engineering	C ₁
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(a) An ability to apply knowledge of mathematics, science, and engineering	C ₁				

	<p>(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability T_E</p> <p>(e) An ability to identify, formulate and solve engineering problems T_I</p> <p>(f) An understanding of professional and ethical responsibility C_I</p> <p>(g) An ability to communicate effectively T_I</p> <p>(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context C_I</p> <p>(i) A recognition of the need for, and an ability to engage in life-long learning C_I</p> <p>(j) A knowledge of contemporary issues C_I</p> <p>(k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice T_I</p> <p><u>*Notes</u></p> <p>Covered Implicitly (C_I): The outcome is implicitly covered Covered Explicitly (C_E): The outcome is explicitly covered Tested Implicitly (T_I): The outcome is covered and implicitly assessed for by one or more means (assignments, test questions, essay questions, presentation evaluations, lab reports, etc.) Tested Explicitly (T_E): The outcome is explicitly assessed for by one or more means</p>
<p>CE 4347, a “Design” Course</p>	<p>The Civil Engineering Department ABET procedure includes assessing the achievement of various departmental student learning outcomes. CE 4347 is designated as a “Design” course for the CE Department, through which the following outcomes will be assessed:</p> <p><i>CE Department Outcome “c”:</i> An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.</p> <p><i>ABET CE Program Outcome:</i> An ability to design a system, component or process in more than one civil engineering context.</p> <p><u>The following process will be followed in this course towards assessing the outcomes:</u></p> <ol style="list-style-type: none"> 1. There will be a design term project, including both analysis and synthesis requiring at least three weeks of effort. 2. The project must have some iterative components. Students will be encouraged to define the design problem, including scope and design objectives. 3. The course project will be open-ended, with at least a few alternate solutions. 4. The course project or assignment should include any applicable codes and regulations, and also a minimum of two realistic design constraints from the following list: economic, environmental, social, political, ethical, health and safety, constructability, and sustainability. 5. A design summary report must be completed by students at the semester end, including a documented analysis of alternatives and constraints consideration. 6. The minimum passing grade in the project is 70. 7. The project grade will also count towards your overall course grade, as discussed later.

**Student
Responsibility**

Deadlines and Instructions

Following professional conduct that you will be expected to demonstrate in practice, the course contains strict deadlines, instructions and professionalism. Please read instructions carefully and schedule your activities accordingly to meet schedules. You should check your e-mail and the Blackboard course web page regularly, and note other announcements, on-line and in class.

Class Participation

Class participation can be achieved in two ways. I shall ask your group and you questions in class on the previous lectures, and on the material currently being discussed. You should be prepared to answer these questions, and should also participate by asking questions, suggesting ideas, and performing in-class group activities that I assign. I prefer an interactive class-room where the instructor and the students freely participate in active learning. Of course, you cannot participate in class unless you attend it!

Group Work

You must work in groups of three on the following activities: homework, class quizzes and term project. The groups should represent diversity in terms of student background and academic performance. You should participate in all group activities and make a fair contribution to the group effort.

Homework

Required homework will be due at the beginning of the period on the due date - one solution set per group. Use engineering paper, one side of each paper, and box the solution. On the inside, put the name of the group leader, all other participating group members, the date, and the assignment number. If a student's name appears on a solution set, it certifies that he/she has participated in solving some of the problems and understands all the solutions. If this turns out not to be the case, both the student in question and the group leader will be considered to have cheated and will be dealt with accordingly. Please keep a copy of your homework before it is submitted in case the homework is lost or misplaced. Late homework will be accepted for up to two weeks after the due date. A penalty of 20% for each 24 hours will be assessed on late homework. However, if a group abuses this privilege on a regular basis, it will be withdrawn. One group member should be designated the leader for each homework. The leader will be responsible for coordinating the work and making sure everyone in the group understands all the problem solutions before they are handed in (Hint: Try to set up each problem individually, then get together to work out the details). After being a group leader, an individual may not be leader again until everyone else in the group has held the position.

Help Session Attendance

Two help sessions per week will be arranged outside the regularly scheduled class period. Although attendance in these sessions is not required, it is highly recommended. The GTA will provide you with helpful hints on homework, solve additional problems, and help you with your term project and software usage.

Term Project

A group term project is required as a part of this class. The topic will be practice oriented, will require design code usage, latest design software and drafting applications. The instructor will supply the class with the project concept during the

	<p>second week of classes. A written proposal, oral final presentation and written final report are required. The project grade will be based on the following:</p> <p>Proposal: 30% Oral presentation: 30% Final report: 40%</p> <p>You must be able to understand, explain and execute your group project work. About half of the group project grade will be based on group activities, and the other half based on your individual contribution. Therefore, when asked, you should be able to explain and clearly identify your own contribution.</p>		
Professional Component of the Course	The course will teach senior level civil engineering students how to efficiently analyze and design real life buildings and bridges made of reinforced concrete, using the latest available professional codes, methods and tools. Professional level group term project is also involved.		
Topics/ Tentative Time Schedule/ No. of Sessions	<p style="text-align: center;"><u>Course Topics</u></p> <p>Introduction: Reinforced concrete (RC), building and design codes, service and ultimate loads, the ACI analysis and design process, structural safety, types of RC structures, loads.</p> <p>Materials: Mechanical properties of concrete and reinforcing steel, compression/tension/stress-strain, types of reinforcement.</p> <p>Beam Design for Flexure: Service conditions, compressive stress block, flexural strength, load and capacity factors, strength design and analysis, reinforcement limits, steel choice and placement, open ended design.</p> <p>Project proposals due</p> <p>Flanged beams: Effective flange width, steel limits, effect of moment reversal, continuous spans.</p> <p>One-way slabs: two-way vs. one-way construction, moment coefficients, steel limits and placement, temperature and shrinkage steel.</p> <p>TEST 1</p> <p>Spring Break (classes in Cancun!)</p> <p>Serviceability: deflections, short and long term effects, equivalent Moment of Inertia, deflection limits, crack control.</p>	<p style="text-align: center;"><u>Dates (2018)</u></p> <p>01/16 – 01/18</p> <p>01/23 – 01/25</p> <p>01/30– 02/15</p> <p>02/22</p> <p>02/20 – 02/27</p> <p>03/01 – 03/06</p> <p>03/08</p> <p>03/13 – 03/15</p> <p>03/20 – 03/22</p>	<p style="text-align: center;"><u>Sessions</u></p> <p>2</p> <p>2</p> <p>6</p> <p>---</p> <p>3</p> <p>2</p> <p>1</p> <p></p> <p>2</p>

	Shear Design: shear failure in reinforced concrete beams, shear steel and limits, shear strength of concrete, stirrup placement.	03/27 – 04/03	3
	Guest Lecture	04/05	1
	Bond and Anchorage: Bond stress, development length of steel, cutoff points and anchorage.	04/10 – 04/12	2
	Field Trip	04/17	1
	Columns: Fundamentals of column behavior, beam-columns, short column strength, interaction diagrams.	04/19 – 04/26	3
	Test 2	05/01	1
	Term Project presentations	05/03	1
	Optional Final Test (comprehensive)	05/08 (11 am – 1:30 pm)	---
Grading Criteria	<p>The overall course grade will be based on the performance of each student in the following categories: homework, tests, term project, and class participation.</p> <p>The following lists the published grade percentage distributions for in-class students:</p> <p>Homework: 19% Two tests: 27% each Term project: 20% Class participation: 7%</p> <p>A weighted grade of 90 or above overall is guaranteed an A grade, 80 or above at least a B grade, 70 or above at least a C grade, and 60 or above at least a D grade. Exceptions from the published grade scales may be made based on the overall course grade statistics, and the following factors: (a) your participation in class, (b) your interaction with the instructor, GTA and other students in the class, (c) your leadership demonstration. The exception is solely at the discretion of the course instructor and is sparingly applied.</p>		
Prepared By	<i>Nur Yazdani, Ph.D., P.E.</i>		

COURSE POLICIES

Examinations: There will be two regular tests during the semester and one optional final examination. The instructor understands that students may have a down day once in a while, which may affect their test grades. As a compensation for extenuating circumstances affecting your test grades, you may take the optional comprehensive final examination, which will be

scheduled during the final examination week. If you take this optional test, the grade from this test will substitute the grade from one of the regularly scheduled tests. If you miss any test for emergency reasons, a cumulative make-up test will be scheduled during the last week of classes. All students missing any test will be given the opportunity to take this make-up test. The student must submit admissible evidence of emergencies that prevented them from taking the regularly scheduled examination.

Attendance: At UT Arlington, taking attendance is not required. Rather, each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this course, I strongly encourage you to make every effort to attend all lectures. I may cover material from outside the text-book which will be useful supplementary material. I shall also use visual aids, practical cases, class interaction and thoroughly worked out example problems to enhance learning. In my opinion, keeping attendance record is a poor and inefficient practice. However, students attending lectures will be indirectly credited through group activities (see grading policy and group activities). In emergency situations, absence may be excused with appropriate documentation. You should let me know in advance, when possible, and submit the documentation. You should make up any materials missed due to the absence.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://wweb.uta.edu/aao/fao/>).

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including The Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD), www.uta.edu/disability or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services, (CAPS). www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues,

address mental and behavioral health problems and make positive changes in their lives.

Title IX Policy: The University of Texas at Arlington is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence. I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents' Rule 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>.

Student Support Services Available: UT Arlington supports a variety of student success programs to help you connect with the University and achieve academic success. These programs include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.

Final Review Week: For semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabus. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>.

Student Feedback Survey: At the end of each term, students enrolled in face-to-face and online classes categorized as “lecture,” “seminar,” or “laboratory” are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback via the SFS database is aggregated with that of other students enrolled in the course. Students’ anonymity will be protected to the extent that the law allows. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is located on the west side of Nedderman Hall first floor. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Professional Ethics: You will gain confidence in your ability to design and analyze concrete structures only when you do the work yourself. However, you will also learn a lot through discussions with your peers. In order to balance the two goals, the following guideline is provided:

- *Things you may not do:* You should not copy work from others. This includes directly copying homework, tests, project materials, etc, and submitting it as your own work. Furthermore, you should assure that others cannot copy your work. Allowing copying of your material will only hinder the learning of the parties involved.
- *Things you may do:* You may discuss specific problems related to analysis/design steps, Code usage, software usage, efficient design, and project issues with others.

Technology and Practice: The course work will be heavily geared towards technology and practice. Students will be asked to contact outside sources such as design/construction industry

and vendors in order to obtain information. Problems in the class and homework will be designed to utilize this information. Commercial software similar to the ones used by industry design offices will be demonstrated in the classroom. Students will be able to use the software from the college computer labs. It is expected that at least one field trip to a concrete construction site will be arranged during the semester, where you can obtain valuable practice oriented knowledge as complementary to the classroom knowledge. Guest speakers from the industry will be invited to speak to the students.

Emergency Phone Numbers: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911.

Syllabus Change Policy: This syllabus is a guide for the course and is subject to change with advance notice.