# COURSE CONTENT

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| **Academic Year** | AY2017-18, | **Semester** | 2 |
| **Course Coordinator** | Asst Prof Zhao Ou | | |
| **Course Code** | CV4120 | | |
| **Course Title** | Advanced Reinforced Concrete Design | | |
| **Pre-requisites** | CV3011 Reinforced Concrete Design | | |
| **No of AUs** | 3 | | |
| **Contact Hours** | Total : 39 Hours (Lectures: 26 hrs and tutorials: 13 hrs) | | |
| **Proposal Date** | 27 April 2017 | | |

**Course Aims**

The aim of this course is to keep students up to date with various advanced mechanics and theories on reinforced concrete structures and to develop your skills to conduct analysis and practical design of real-life RC structures.

**Course Learning Outcomes (Course LO)**

By the end of this course, the students would be able to:

1. Apply Strut and Tie Model (STM) in the design of disturbed (D) regions of reinforced concrete structures, such as corbels, brackets and beams with openings.
2. Analyse and design of slabs using two collapse load methods – Yield Line Method and Strip Method.
3. Evaluate the function of structural walls and design of shear walls in buildings.
4. Analyse and design framed structures.
5. Calculate deflections at serviceability limit state and understand methods of deflection control.
6. Calculate crack widths at serviceability limit state and understand methods of crack control.
7. Interpret the design requirements for water-retaining structures, and conduct preliminary design.

**Course Content**

**Propose Course outline**:

| S/N | Topic | Lecture Hrs | Tutorial Hrs |
|---|---|---|---|
| 1. | Strut and Tie Models | 4 | 2 |
| 2. | Analysis and design of slab system | 2 | 1 |
| 3. | Yield Line Method for slab design | 3 | 2 |
| 4. | Strip Method for slab design | 2 | 1 |
| 5. | Design of walls and shear walls | 2 | 1 |
| 6. | Design of framed structure | 4 | 2 |
| 7. | Design for Serviceability Limit State: Deflection | 3 | 1.5 |
| 8. | Design for Serviceability Limit State: Crack | 3 | 1.5 |
| 9. | Water-retaining structures | 3 | 1 |
| | Total: | 26 | 13 |

**Assessment (includes both continuous and summative assessment)**

| Component | Course LO Tested | Related Programme LO or Graduate Attributes | Weighting | Team/Individual | Assessment Rubrics |
|---|---|---|---|---|---|
| 1. Final Examination | 1, 2, 3, 4, 5, 6, 7 | EAB SLO* a,b,c | 60% | Individual | |
| 2. Continuous Assessment 1 (CA1): Quiz 1 | 1, 2 | EAB SLO* a,b,c | 20% | Individual | |
| 3. CA2: Quiz 2 | 5, 6 | EAB SLO* a,b,c | 20% | Individual | |
| Total | | | 100% | | |

* EAB SLO stands for the Engineering Accreditation Board Student Learning Outcomes.

**Related Programme LO or Graduate Attributes**

a. **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems;

b. **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences;

c. **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d. **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

e. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**Formative feedback**

Quiz feedback will be given to students for the common mistakes during lecture class.

**Learning and Teaching approach**

| Approach | How does this approach support students in achieving the learning outcomes? |
|---|---|
| Lecture | Weekly lectures to provide students with the necessary knowledge to achieve the learning outcomes |
| Tutorial | Weekly tutorials to enable the students to apply the knowledge into practice and hone their skills to achieve the learning outcomes |

**Reading and References**

Darwin, D., Dolan, C.W. and Nilson, A.H., "Design of Concrete Structures", 15th edition, McGraw-Hill, New York, 2016.

Mosley, W.H., Hulse, R. and Bungey, J.H., "Reinforced Concrete Design to EuroCode 2", 7th edition, Palgrave Macmillan, London, 2012.

Wight, J.K., "Reinforced Concrete: Mechanics and Design", 7th edition, Pearson/Prentice-Hall, 2015.

**Course Policies and Student Responsibilities**

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct. The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of your mental health and wellbeing. These policies and codes concerning students can be found in the following link.
http://www.ntu.edu.sg/SAO/Pages/Policies-concerning-students.aspx

**Academic Integrity**

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

**Course Instructors AY2017/18**

| Instructor | Office Location | Phone | Email |
|---|---|---|---|
| Tan Kang Hai | N1-01a-27/N1-01c-97 | 6790 4104P/ 5297 | CKHTAN@ntu.edu.sg |
| Zhao Ou | N1-01b-49 | 6790 6934 | ou.zhao@ntu.edu.sg |

**Planned Weekly Schedule**

| Week | Topic | Course LO | Readings/ Activities |
|---|---|---|---|
| 1 | Strut and Tie Models | 1 | Tutorial and lectures |
| 2 | Strut and Tie Models | 1 | Tutorial and lectures |
| 3 | Analysis and design of slab system | 2 | Tutorial and lectures |
| 4 | Yield Line Method for slab design | 2 | Tutorial and lectures |
| 5 | Yield Line Method for slab design | 2 | Tutorial and lectures |
| 6 | Strip Method for slab design | 2 | Tutorial and lectures |
| 7 | Design of walls and shear walls | 3 | Tutorial and lectures |
| 8 | Design of framed structures | 4 | Tutorial and lectures |
| 9 | Design of framed structures | 4 | Tutorial and lectures |
| 10 | Design for Serviceability Limit State: Deflection | 5 | Tutorial and lectures |
| 11 | Design for Serviceability Limit State: Crack | 6 | Tutorial and lectures |
| 12 | Design for Serviceability Limit State: Crack | 6 | Tutorial and lectures |
| 13 | Water-retaining structures | 7 | Tutorial and lectures |