McMaster University
Department of Civil Engineering

CIV ENG 3P04 - CIVIL ENGINEERING MATERIALS AND DESIGN
(Course Website: Follow the links from http://avenue.mcmaster.ca )

Course Instructors: Dr. Ahmed El Refaie

"The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes."

Teaching Assistants: (See course web-site for further information on teaching assistants for the course)

Activities: Total of 36 lectures, 3 hours lab/tutorial per week

Distribution of Marks:
Assignments: 10%
Term Test (Closed Book): 25%
Concrete Mix-Design Project: 25% [Note: Without completing the project, one cannot pass the course]
Final Examination (Closed Book): 40%

The percentage marks will be converted to final letter grade using the standard conversion scale shown in the McMaster Undergraduate Calendar.

Term Test: There will be a term test for the course to be given in the last week of October. Exact time and location will be announced soon. This is a closed book test, and as such, books and notes are NOT permitted during the term test (as well as during the Final Examination).

- Any conflict between the term test and any other courses must be brought to the attention of the instructor immediately after the announcement is made, so that alternate arrangements may be made.
- Missed Term Test: Please see McMaster Undergraduate Calendar for the relevant policy. Accordingly, please contact the associate dean of engineering in order to obtain permission for relief. If such a relief is granted, a makeup test may be arranged. Such a makeup test will include course materials covered in the lectures up to two days before the makeup test. The instructor has the right to make an oral or a written makeup exam.

Reference Text Books


Note: You may want to use the references to gain additional knowledge or information, but the course does not have an assigned textbook. Course material, including those related to the concrete lab, will be posted on the course website.

Safety

A major part of this course is the concrete lab or project, which involves hands-on team work at the Applied Dynamics Lab. Individual and collective safety is paramount during the lab sessions and students must be cognizant of and adhere to the written instructions given in the lab manual and the oral instructions given by lab technicians, TA's or the instructor. For the lab safety requirements, refer to the lab manual for this course posted on the course website.
### COURSE CONTENT:

<table>
<thead>
<tr>
<th>TOPICS</th>
<th>Approx. No. of Lectures</th>
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<tr>
<td><strong>Concrete:</strong> Concrete composition; Properties of aggregates and cement; Concrete mix-design; Control of concrete mix; Fresh concrete properties; Hardened concrete properties; Response to environmental changes and chemical attack. (<em>Useful references [1] and [3]</em>)</td>
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<td><strong>Mechanical Properties of Materials:</strong> Homogeneity, isotropy, stress-strain relations, Hooke’s Law Basis of some mechanical and physical properties. Fatigue, fracture and long-term response to sustained stresses (<em>Useful reference [2]</em>)</td>
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<td><strong>Steel and other Ferrous Metals:</strong> Steel composition, production and products; Metal forming; Factors affecting the mechanical properties of steel; Strengthening mechanisms; Other ferrous metals: wrought iron, cast iron, stainless steel; Structural steel products and their properties; Steel reinforcement for concrete and their properties; Steel corrosion (<em>Useful references [2] and [3]</em>)</td>
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<td><strong>Wood:</strong> Constituents and classification; Properties of wood; Wood defects and their effect on strength and stiffness; Wood seasoning; Wood deterioration and its remedy; Grading of wood products. (<em>Useful reference [3]</em>)</td>
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<td><strong>Plastics and composites:</strong> Chemistry of polymers; Types of plastics and their general properties; Fibre reinforced polymer (FRP) composites; Types of fibres and matrices; Properties of FRP composites; Applications of FRP in construction. (<em>Useful reference [2]</em>)</td>
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<td><strong>Concepts of Structural Design:</strong> Material and load uncertainty; Types and basis of design principles- Allowable (working) Stress Design, Limits States Design; Introduction to the National Building Code of Canada and Structural Design Standards; Estimation of dead load, live loads- use and occupancy, snow loads, wind loads, earthquake loads, loads due to temperature change.</td>
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**Total:** 36
Learning Outcomes:

1. Knowledge of most common construction materials, including concrete, structural steel and wood.
2. Understanding their important properties relevant to the design, construction and performance of structures made of these materials.
3. Understanding the key factors that affect the various engineering properties of these materials.
4. Ability to characterise aggregates used in concrete, calculate the proportion a concrete mix for target strength and durability, blend the ingredients and produce the actual mix.
5. Perform the key laboratory tests to assess the strength and some other mechanical and physical properties of the produced concrete.
6. Analyse systematically the test data, discuss the findings and report the results in a coherent form.
7. Understanding the composition and relevant properties of reinforcing and structural steels as well some other ferrous alloys, and the Canadian CSA standards specifications for meeting specified requirements.
8. Understanding the composition, key properties and advantages and disadvantages of fibre reinforced polymers (FRP) in construction.
9. Understanding the structure, properties and use of wood in construction and its limitations; the factors which influence the mechanical properties and durability of wood.
10. Understanding the structural design process and the concepts of load and resistance.
11. Understanding the concepts of uncertainty in design and its effect on the safety and serviceability of structures, with particular focus on the National Building Code of Canada.

Relevant Attributes

1. Competence in natural sciences
2. The ability to manage time and processes effectively, prioritizing competing demands to achieve personal and team goals and objectives
3. Ability to address uncertainties in the prediction of interactions on society and the environment in a structured and transparent manner
4. Ability to assess possible options and design configurations from a sustainability engineering perspective, which emphasizes environmental stewardship, life cycle analysis and long-term decision making
5. Ability to identify, characterize, assess, and manage risks to project success

Policy Reminders:

Students are reminded of the following Policies, which may be relevant to activity in this course.

- **Calculators:** Only McMaster Standard Calculator (Casio fx-991) may be used during quizzes, term tests, and final examination.
- **Adverse Discrimination:** "The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible."
- **Academic Integrity (Ethics and Dishonesty):** "Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at [http://www.mcmaster.ca/senate/academic/ac_integrity.htm](http://www.mcmaster.ca/senate/academic/ac_integrity.htm). The following illustrates only two forms of academic dishonesty: 1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. 2. Copying or using unauthorized aids in tests and examinations."