COURSE CALENDAR DESCRIPTION

This course provides an introduction to numerical modeling (e.g., finite element analysis) and commercial software of choice. The application of commercial software to a selected number of problems (e.g., stress analysis, heat transfer, and/or fluid flow, etc. to design or analyze a system) is discussed. Result verification/interpretation of numerical modeling are emphasized. Prerequisites: LE/EECS 1011 3.00, LE/MECH 2301 3.00, SC/MATH 2271 3.00, and LE/MECH 3203 3.00

INSTRUCTOR(S)

<table>
<thead>
<tr>
<th>Name</th>
<th>Section / Format / Term</th>
<th>Contact Email</th>
<th>Contact Phone</th>
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<tbody>
<tr>
<td>Hanson, Ronald</td>
<td>Sec. A / LECT / F</td>
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<tr>
<td>Czekanski, Aleksander</td>
<td>Sec. A / LECT / F</td>
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TOPICS AND CONCEPTS

This is a course that develops the knowledge and skills that mechanical engineers need in modeling and simulation of mechanical systems. The gained knowledge and experiences in this course will be essential for any future project, engineering activities, and graduate research.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Detailed Contents</th>
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<tbody>
<tr>
<td>1</td>
<td>Fundamentals of modeling and simulation</td>
<td>Basic concepts of modeling &amp; simulation, Classification of modeling (physics based, empirical …), Importance of the computer modeling and simulation.</td>
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<tr>
<td>1-2</td>
<td>Engineering Problems and Governing Equations</td>
<td>Introduction to engineering problems and governing equations involving stress analysis, heat transfer, fluid flow, etc.</td>
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<tr>
<td>6-7</td>
<td>Finite Element Formulations</td>
<td>Finite element modeling, Shape functions, Finite element formulation of selected engineering problems (e.g., Stress analysis and heat transfer).</td>
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<td>8</td>
<td>Finite Element Analysis Examples</td>
<td>Creating a model, Applying boundary/initial conditions, Analysis example solid mechanics, heat transfer, and fluid flow.</td>
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<td>9</td>
<td>Introduction of commercial modeling and analysis software</td>
<td>Introduction to commercial computer aided design and computer aided engineering (CAD/CAE) software (SolidWorks®, COMSOL Multiphysics®, ANSYS Multiphysics®,…), Modeling examples in solid mechanics, heat transfer, fluidodynamics, etc.</td>
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Verification and Validation of Computer Modeling & simulation results

Approaches to deciding model validity, Common techniques used for verification and validation (e.g. animation, comparison to other models/experiments, parameter variability, Face validity, operational validity, etc.)

Multiphysics Software

Introduction to Multiphysics software, Examples of Multiphysics problems with additional interfaces for electrical, mechanical, fluid flow, etc. Definition of boundary conditions (interfaces) in Multiphysics computer modeling.

The following software will be employed and/or discussed (upon availability of licenses) during the lecture and tutorial sessions. The students will use some of these software to complete their assignments and course projects. This will help the students to have a better understanding of the modeling and simulation software as well as helping them to have an exposure to the commercial software available in industry and research centers.

SolidWorks®: SolidWorks is a CAD/CAE software used for design, modeling, and simulation/analysis in commercial industries such as aerospace, automotive, construction, energy, electronics, etc.

Program Learning

Matlab® (or any other programming language upon availability): MATLAB® is a high-level language and interactive environment for numerical computation, visualization, and programming.

COMSOL Multiphysics®: COMSOL Multiphysics can model and simulate any physics-based system. It is a platform for physics-based modeling and simulation.

ANSYS Multiphysics®: Abaqus and Altair Hyperwork ANSYS offers a comprehensive software suite that spans the entire range of physics, providing access to virtually any field of engineering modeling and simulation

COURSE LEARNING OBJECTIVES

- Appraise the importance of modeling and simulation in engineering design and analysis.
- Formulate the solutions of engineering problems (e.g., stress analysis, heat transfer) using finite difference method and finite element method.
- Use commercial engineering software (SolidWorks, Matlab, etc.) to model engineering systems.
- Establish a process to verify and validate computer models and simulation results.
- Identify the capability of various engineering software in design, modeling and simulation and ability to select a proper software for specific task.
- Describe the importance of multiphysics software and to employ for modeling and simulation of multiphysics problems.

GRADED ASSESSMENT

The following table shows the proposed percentage breakdown for the course (subjected to change when the course director designs the course):

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage (%)</th>
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<tbody>
<tr>
<td>5 Assignment Problem Sets (10% each)</td>
<td>50</td>
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<tr>
<td>Midterm Exam</td>
<td>20</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30</td>
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ADDITIONAL INFORMATION
REQUIRED TEXTBOOK

The course will use one of the following textbook:

Fundamental Finite Element Analysis and Application
By M. Asghar Bhatti

RECOMMENDED

COMSOL Multiphysics® Modeling Software: https://www.comsol.com
ANSYS Simulation Software: http://www.ansys.com/?gclid=CI6X_8jU-ssCFQYuaQodZToMOA
Mechanical Engineering, (ASME): The Magazine of American Society of Mechanical Engineers
SmartBrief | Industry News & Newsletters: http://www.smartbrief.com/

EXAMPLE JOURNALS


ACADEMIC INTEGRITY LINKS

• Senate Policy on Academic Honesty - http://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/
• Academic Integrity - http://lassonde.yorku.ca/academic-integrity

STUDENT LINKS

• Student Rights and Responsibilities - http://oscr.students.uit.yorku.ca/student-conduct
• Religious Observance - https://w2prod.sis.yorku.ca/Apps/WebObjects/cdm.woa/wa/regobs
• Academic Accommodation for Students with Disabilities - http://secretariat-policies.info.yorku.ca/policies/academic-accommodation-for-students-with-disabilities-policy/
• Counselling and Disability Services - http://cds.info.yorku.ca/

Many courses utilize Moodle, York University’s course website system. If your course is using Moodle, click here to access it.

Moodle @ York University