

Course Outline: M. Eng. 4Z03/6Z03 - January 2020

Instructor

- Patrick Hale, halep@mcmaster.ca

Teaching Assistants

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Calendar Description

- Solid modeling theory, part creation, assemblies and rigid bodies, mechanism simulation, B-Splines, data exchange, CNC machining and inspection, CAE analysis, Topology optimization.
- Major project using computer laboratory facilities.

Textbook

- Zeid, I., Mastering CAD/CAM, 2004, McGraw-Hill, ISBN 0072868457 (optional)

Lectures

- Tuesday, 7:00pm-10:00pm beginning Jan. 7, 2020, HH302.

Corresponding textbook chapter references, and a planned schedule are listed below.

Laboratory

- Laboratories are held weekly beginning Jan. 13, 2020. There are limited laboratory seats, so priority is given to students attending their scheduled lab section.

L01 Friday 12:30pm-1:20pm, JHE 219A

L02 Wednesday 2:30pm-3:20pm, JHE 219A

L03 Wednesday 11:30am-12:20pm, JHE 219A

L04 Monday 10:30am-11:20am, JHE 219A

L05 Monday 4:30pm-5:20pm, JHE 219A

L06 Tuesday 2:30pm-3:20pm, JHE 219A

L07 Friday 2:30pm-3:20pm, JHE 219A

- The required software is installed in the JHE 219A laboratory and the scheduled laboratory hours will be devoted to assisting students to use the software, as well as grading the assignments and project. Hence attendance at the laboratories is mandatory. Students needing for special accommodation must identify themselves to the instructor no later than the end of the January 18, 2020 lecture.

- Access to the JHE 219A laboratory is acquired using a magnetic card available from the Engineering DocuCentre (JHE 216A). McMaster Security monitors the door open status, so the door must not be blocked open.
- The laboratory uses the UTS computer login and printing access procedures.
- It is suggested that you either use an online cloud storage service or purchase a USB Memory Stick with at least 4 GB capacity to store your personal files.
- Ask a TA or the Mechanical Engineering technical staff (John Colenbrander, colenbjw@mcmaster.ca) if the facilities need attention (computer failure, etc).
- Use of JHE 219A is governed by the Conduct for Computer and Network Users. A copy is available online at <http://www.mcmaster.ca/uts/policy/netcond.htm>. Specifically, because of high laboratory enrollment, students are not to leave computers locked for long periods when away from the room.
- Your cooperation in maintaining tidy conditions is essential. Properly dispose of waste items. Food / drink is not permitted. Violation may lead to revocation of laboratory access privileges.

CAD Software

- The principal software is Siemens NX10. Portions of the class will use Autodesk Fusion 360. The university licensed NX software will be made available for home use through Cisco VPN login credentials. You can download a student copy of Autodesk Fusion 360 from:
<http://www.autodesk.com/education/home>.
- Note that no support is offered for home computer software installation.

Main Topics

1. Introduction
 - Design Thinking Exercise, Sculptured Surface Body, CNC Machining Software Tools
 - Components of a CAD software program
 - Examples: Siemens NX, Autodesk Fusion 360
2. Solid Modelling Review (Zeid Ch. 1,2,9,18)
 - Primitives, Boolean Operations, Constructive Solid Geometry, Boundary Representation
 - Sketches, Shape then Size Paradigm, Parametric Constraints
 - Extruded, Revolved, Pattern, Mirror Features, Datum (Work) Features
 - Data Representation and Interchange - IGES, STEP, direct translation, VB programming
 - *CAD Demonstration (NX, VB Programming, Interchange with Autodesk Inventor)*

Assign. 1 - Solid Modelling and Data Interchange (10%), Jan. 24, 2020, 11:30pm,
3. Assemblies and Kinematic Mechanisms (Zeid Ch. 12,15,16,18)
 - Coordinate Systems, Homogeneous Transformation Matrices
 - Material Properties, Area, Volume, Mass Calculations
 - Assembly Modelling, Kinematic Mechanisms

Assign. 2 - Assemblies and Kinematic Mechanisms (10%), Feb. 7, 2020, 11:30pm,
4. CNC Machining, GD&T, and Inspection (Zeid Ch. 20, 22)
 - Hole Drilling, 3-axis Pocket Machining, Surface Ball Nose Milling
 - G-Codes, Post Processing
 - Introduction to GD&T, PMI, and Coordinate Measuring Machine (CMM) Inspection

Assign. 3 - CNC Machining & GD&T (10%), Feb. 28, 2020, 11:30pm, Avenue2Learn
Assign. 4 - CAE Analysis & Shape Optimization (10%), Mar. 13, 2020, 11:30pm, Avenue2Learn

5. Bezier and B-spline Curves and Surfaces (Zeid Ch. 6,7,8,13)

- Bezier and B-spline curves and surfaces, NURBS
- Visualization Techniques
- CAD Demonstration Autodesk Fusion 360

Assign. 5 (10%) - Realize Shape, Mar. 27, 2020, 11:30pm, Avenue2Learn

Project Proposal (2%), Jan. 31, 2020, 11:30pm, Avenue2Learn

Project CAD (pre-optimized) Model (2%), Mar. 20, 2020, 11:30pm, Avenue2Learn

Project Final Report/CAD/CAM/CAE (16%), Apr. 3, 2020, 11:30pm, Avenue2Learn

Final Examination (30%) - scheduled by the Registrar

Learning Outcomes

Upon successful completion of the course the student will be expected to have demonstrated theoretical knowledge and best practices ability to:

1. Utilize an engineering tool design process for creating, assembling, and simulating kinematic motion of assembled components, using the state of the art Siemens NX software (adopted by General Motors, Chrysler, FIAT, Daimler-Benz, etc.)
2. Utilize standards such as IGES and STEP for exchanging data between CAD software systems.
3. Understand CNC programming methods and languages for machine tools. Utilize introductory GD&T and the Dimensional Measuring Interface Standard (DMIS) for CMM inspection.
4. Utilize B-spline sculptured surface mathematics theory and concept shape design principles to develop an aesthetically pleasing part shape.
5. Utilize manufacturing engineering process planning principles to create CNC cutting tool paths for planar hole drilling and contouring, and for milling of sculptured surfaces with ball end mills. Utilize GD&T/CMM inspection planning principles to create appropriate and collision free measurement paths.

Graduate Attributes

This course provides the students with the opportunity to develop the following measures of graduate attributes

Graduate Attributes	Learning Outcomes where it is measured
A04 Design (4.01 Recognize/Follow Engineering Design Process)	1,3 (Assignments)
A04 Design (4.06 Determine/Employ Standards and Codes of Practice)	2,5 (Assignments)
A04 Use of Engineering Tools (5.01 Evaluate/Select Appropriate Tool)	4 (Project/Exam)

A05 Use of Engineering Tools (5.02 Use modern/state of the art tools)	General (Assignments/Project)
A05 Use of Engineering Tools (5.03 Create/adapt/modify tools/techniques)	6 (Project)

Grading

There are four combined laboratory/homework Assignments (each 10%), a in-class assessment (10%), a project (20%), and Final Examination (30%). The only permitted aid at the Final Exam is the McMaster Standard Calculator. Assignments and the Project are to be submitted on-time using the Avenue2Learn system. Late assignments are not accepted. Students enrolled in Mech Eng 6Z03 must complete the 4 assignments (at reduced weight) plus a additional assignment described in a separate hand-out.

- For Mech Eng 4Z03 students, the final grade will be calculated as Assign.1-4 (40%) + Project (20%) + In-Class assessment (10%) + Final Exam (30%) = 100%
- For Mech Eng 6Z03 students, the final grade will be calculated as Assign.1-4 (30%) + Assign.5 (10%) + In-class Assessment (10%) + Project (20%) + Final Exam (30%) = 100%

Mandatory Policy Statements and Clarifications

- Standard undergraduate course management policies are available at the link <http://www.mcmaster.ca/policy/Students-AcademicStudies/UGCourseMgmt.pdf>

Clarifications specific to this course are provided below.

- Online Course Website - <https://avenue.cllmcmaster.ca/>
- Used to communicate non-confidential general notes, files, etc.
- Used for student submissions, grade release, etc.
- Instructor email: halep@mcmaster.ca
- Late work: will be dealt with on an individual basis guided by university policies.
- Attendance expectations: Students are expected to attend all course elements including scheduled laboratory periods. Attendance at lectures is expected, and at the instructor's discretion attendance may be taken.
- Unexcused frequent lecture absence will be addressed in a private office meeting with the instructor. Distracting cell phone, tablet, and laptop computer use is not acceptable during lectures. If you anticipate the need to monitor your cell phone for an urgent message, please sit near the lecture room entrance so that you can leave quietly. Violators will be asked to leave the room, will be recorded as absent, and the matter will be addressed at a private office meeting with the instructor.

Academic integrity

It is your responsibility to understand what constitutes academic dishonesty. The Academic Integrity Policy is available at the link:

<http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf>

Clarifications specific to this course are provided below.

- You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.
- Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour 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.

The following illustrates possible 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. Improper collaboration on assignments or project. Ask the instructor or TA if uncertain.
3. Copying or using unauthorized aids in tests and examinations. Automated plagiarism methods will not be used, and student submissions will not be retained in a database beyond the private Avenue2Learn submission and grading tool. However, the instructor and TAs may verify originality of submitted work using other verification methods.

On-Line Element:

- Avenue2Learn are used to administer the course. These tools are used to increase efficiency. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

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 their Department Chair, or the Human Rights and Equity Services office, as soon as possible. The university Ombuds Office is also available. Details on the adverse discrimination policy are located:

<http://www.mcmaster.ca/respectfulcommunity/policy-procedures.html>

Academic Accommodation of Students with Disabilities Policy:

- The related policy is available at the link:

<http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicAccommodation-StudentsWithDisabilities.pdf>

- To receive accommodation in a timely manner, students must communicate requirements at the beginning of the course or as soon as possible after the need for a special accommodation is identified. Accommodation is not offered retroactively.

Right to modify course elements:

- 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, including but not limited to inclement weather or technical difficulties with computer equipment. 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, course websites weekly during the term, note any changes, and promptly contact the instructor with any concerns.

Materials and fees:

- A printed copy of the Zeid textbook is optional. It is not a permitted aid at the Final Examination.

Common sense:

- The overarching expectation in the course is that everyone will behave with collegiality, respect for authority, common sense, and in the spirit of shared achievement. Most flexible and satisfactory informal resolution of difficulties is achieved by bringing concerns to the instructor and TAs as early as possible. Confidentiality will be respected to the maximum extent possible, consistent with safety and legal reporting requirements.