

Western University
Department of Mechanical & Materials Engineering

MME 4480b – Advanced CAE: Reverse Engineering

COURSE OUTLINE – 2017-18

CALENDAR DESCRIPTION:	This course is an introduction to the use of modern computer-aided design (CAD) techniques in generation of 3D digital models from physical objects. Topics include contact and non-contact data acquisition techniques, data type and exchange formats, and advanced visualization and surfacing techniques.
COURSE INFORMATION:	Instructor: Professor R. Tutunea-Fatan Office: SEB 2063A; Phone 519-661-2111, ext. 88289 E-mail: rtutunea@eng.uwo.ca Lectures: M 11:30-12:20 (SEB 2202) W 10:30-12:20 (B&GS 0153) Labs: M 8:30-10:20 or W 2:30-4:20 (both in SEB 1015)
PREREQUISITES:	MME 2259A/B or MSE 2202A/B
CONSULTATION HOURS:	By advance notice via email or drop in.
ACCREDITATION UNITS:	Engineering Science = 70%, Engineering Design = 30%.
TOPICS:	<ol style="list-style-type: none">1. Introduction to reverse engineering of physical objects<ul style="list-style-type: none">• historical notes on reverse engineering (RE)• overview of RE process2. Data acquisition techniques<ul style="list-style-type: none">• classification of RE techniques• noncontact techniques: laser scanning, CT/MRI• contact techniques: coordinate measurement machine (CMM)• destructive techniques• case studies involving RE• legal aspects3. Data types and data exchange formats<ul style="list-style-type: none">• nonparametric data formats: cloud of points, polygonal mesh• parametric data format (B-Rep/NURBS)• polygonal vs. parametric data• data exchange operations• mitigation of data exchange errors4. Parametric data reconstruction<ul style="list-style-type: none">• nonparametric to parametric data conversion• computer graphics and graphical output of CAD• modeling strategies: history-based and direct• manifold and nonmanifold models• surfacing operations and functionality

- surface quality analysis; class A surfaces
- industrial applications of class A surface
- accuracy of parametric data reconstruction

**LEARNING
OUTCOMES:**

Upon the successful completion of the course, students will:

- Understand the principles underlying data acquisition in the context of reverse engineering of physical objects
- Compare and exploit the capabilities of a particular data acquisition technique to generate accurate digital models of physical artifacts
- Understand the structural differences between the different types of CAD data formats
- Select and use the appropriate format for a CAD data exchange operation
- Understand the theoretical basis of internal CAD representations
- Develop strategies and skills for manipulation and modeling for freeform/complex/sculptured surfaces

CONTACT HOURS: 3 lecture hours, 2 laboratory hours, 0.5 course

**RECOMMENDED
TEXTS:**

Raja V., Fernandes, K.J., *Reverse Engineering, an Industrial Perspective*, Springer-Verlag, 2008.

Zeid I., *Mastering CAD/CAM*, McGraw-Hill, 2005.

Tickoo S., *NX 11 for Designers*. CAD/CIM Technologies, 2016.

Zeid I., *Mastering SolidWorks, the Design Approach*, Peachpit Press, 2014.

EVALUATION:

The final course grade will be determined according to the following weighting scheme:

Assignments	10%
Computer workshops	10%
Project	30%
Final Examination	50%

Please note that:

- Lab session attendance is mandatory.
- Final examination is closed book.
- Only non-programmable calculators will be allowed during the final examination.
- If a minimum of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.

Term assignments and projects will be handed out and collected according to the following **tentative** schedule:

Evaluation Method	Weight	Assigned	Due
Workshop 1	2%	Jan. 15	Jan. 20
Workshop 2	2%	Jan. 22	Jan. 27
Workshop 3	2%	Jan. 29	Feb. 2
Workshop 4	2%	Feb. 5	Feb. 12

Assignment 1	5%	Feb. 5	Mar. 2
Workshop 5	2%	Feb. 12	Feb. 17
Project	30%	Feb. 26	Apr. 9
Assignment 2	5%	Mar. 12	Apr. 9

Term coursework topics:

- Workshop 1: Feature modeling
- Workshop 2: Modeling of curves
- Workshop 3: Surfacing techniques; surface quality assessment
- Workshop 4: Modeling of surfaces
- Workshop 5: Scanned data processing
- Assignment 1: Data type and data exchange capabilities
- Assignment 2: Parametric representation of curves
- Project: Computer-assisted reverse engineering of objects

UNITS: Metric and imperial

ENGLISH: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests and examinations for improper use of English. Additionally, poorly written work, with the exception of final examinations, may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

CLASSROOM DEMEANOR: The instructor is committed to providing a respectful learning environment for all students involved in this course. This is a collective responsibility of the instructor and students, and therefore students partaking in this course agree to abide by this criterion. This includes arriving at lectures on time, and acting in a professional manner during class.

ATTENDANCE: Any student, who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

CHEATING: University policy states that cheating, including plagiarism, is a scholastic offense. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

SSD: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

NOTE: The above topics and outline are subject to adjustments and changes as needed. Students who have failed an Engineering course (ie.<50%) must repeat all components of the course. No special permissions will be granted enabling a student

to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.