MME 4480b – Advanced CAE: Reverse Engineering

COURSE OUTLINE – 2015-16

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: 1. Introduction to reverse engineering of physical objects
- historical notes on reverse engineering (RE)
- overview of RE process

2. Data acquisition techniques
- classification of RE techniques
- noncontact techniques: laser scanning, CT/MRI
- contact techniques: coordinate measurement machine (CMM)
- destructive techniques
- case studies involving RE
- legal aspects

3. Data types and data exchange formats
- 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 errors

4. Parametric data reconstruction
- 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:
Tickoo S., NX 9 for Designers. CADCIM Technologies, 2014.

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

<table>
<thead>
<tr>
<th>Evaluation Method</th>
<th>Weight</th>
<th>Assigned</th>
<th>Due</th>
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</thead>
<tbody>
<tr>
<td>Assignments</td>
<td>10%</td>
<td></td>
<td></td>
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<tr>
<td>Computer workshops</td>
<td>10%</td>
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<tr>
<td>Project</td>
<td>30%</td>
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<tr>
<td>Final Examination</td>
<td>50%</td>
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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:
Term coursework topics:
- Workshop 1: Feature modeling
- Workshop 2: Modeling of curves
- Workshop 3: Surfacing techniques; surface quality assessment
- Workshop 4: Visualization and rendering techniques
- Workshop 5: CT to polygonal mesh data
- 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.
INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

IF, ON MEDICAL OR COMPASSIONATE GROUNDS, YOU ARE UNABLE TO WRITE TERM TESTS OR FINAL EXAMINATIONS OR COMPLETE COURSE WORK BY THE DUE DATE, YOU SHOULD FOLLOW THE INSTRUCTIONS LISTED BELOW. YOU SHOULD UNDERSTAND THAT ACADEMIC ACCOMMODATION WILL NOT BE GRANTED AUTOMATICALLY ON REQUEST. YOU MUST DEMONSTRATE TO YOUR DEPARTMENT (OR THE UNDERGRADUATE SERVICES OFFICE) THAT THERE ARE COMPELLING MEDICAL OR COMPASSIONATE GROUNDS THAT CAN BE DOCUMENTED BEFORE ACADEMIC ACCOMMODATION WILL BE CONSIDERED. DIFFERENT REGULATIONS APPLY TO TERM TESTS, FINAL EXAMINATIONS AND LATE ASSIGNMENTS. READ THE INSTRUCTIONS CAREFULLY. (SEE THE 2015 UWO ACADEMIC CALENDAR).

A. GENERAL REGULATIONS & PROCEDURES

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.

2. If you are an upper year student and you are missing a test/assignment/lab or exam that is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097. Otherwise, you will report to your department office to request accommodation.

3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

4. Documentation must be provided as soon as possible. If no one is available in your Department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.

5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are in first year and you are unable to write a term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.

2. If you are an upper year student and you are unable to write a term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request accommodation. Otherwise, you will report to your department office to request accommodation.

3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. N.B. The approval of the Chair or the Undergraduate Services Office is required when rescheduling term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.

2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.

3. In order to receive permission to write a special examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

N.B. It is the student's responsibility to check the date, time and location of the special examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).

2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).

3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.

4. i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.

   ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.
E. **SHORT ABSENCES**

If you miss a class due to a minor illness or other problems, check your course outlines for information regarding attendance requirements and make sure you are not missing a test or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. **EXTENDED ABSENCES**

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or Ms. Karen Murray in the Undergraduate Services Office, if you are in first year.

G. **DOCUMENTATION**

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, you must provide the doctor with a Student Medical Certificate to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctors notes will not be accepted; only the Student Medical Certificate will be accepted.

**In Case of Serious Illness of a Family Member:** Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**In Case of a Death:** Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**For Other Extemuating Circumstances:** If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. **ACADEMIC CONCERNS**

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

2. You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.

3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

**Calendar References:** Check these regulations in your 2015 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness: [http://www.westerncalendar.uwo.ca/2015/pg117.html](http://www.westerncalendar.uwo.ca/2015/pg117.html)

Academic Accommodations for Students with Disabilities: [http://www.westerncalendar.uwo.ca/2015/pg118.html](http://www.westerncalendar.uwo.ca/2015/pg118.html)


Course Withdrawals: [http://www.westerncalendar.uwo.ca/2015/pg129.html](http://www.westerncalendar.uwo.ca/2015/pg129.html)

Examinations: [http://www.westerncalendar.uwo.ca/2015/pg97.html](http://www.westerncalendar.uwo.ca/2015/pg97.html)

Scheduling of Term Assignments: [http://www.westerncalendar.uwo.ca/2015/pg113.html](http://www.westerncalendar.uwo.ca/2015/pg113.html)

Scholastic Offences: [http://www.westerncalendar.uwo.ca/2015/pg1442.html](http://www.westerncalendar.uwo.ca/2015/pg1442.html)

Student Medical Certificate: [http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)

Engineering Academic Regulations: [http://www.westerncalendar.uwo.ca/2015/pg1442.html](http://www.westerncalendar.uwo.ca/2015/pg1442.html)

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

**Drop Deadlines:**

- First term half course (i.e. “A” or “F”): November 5, 2015
- Full courses and full-year half courses (i.e. “E”, “Y” or no suffix): November 30, 2015
- Second term half or second term full course (i.e. “B” or “G”): March 7, 2016

**Contact Information:**

- Undergraduate Services Office: SEB 2097  Telephone: (519) 661-2130  Fax: (519) 661-3757
- Dept. of Chemical and Biochemical Engineering & Green Process Engineering: TEB 477  Telephone: (519) 661-2131  Fax: (519) 661-3498
- Dept. of Civil and Environmental Engineering: SEB 3005  Telephone: (519) 661-2139  Fax: (519) 661-3779
- Dept. of Electrical and Computer Engineering, Software Engineering & Mechatronics Engineering: TEB 279  Telephone: (519) 661-3758  Fax: (519) 850-2436
- Dept. of Mechanical and Materials Engineering: SEB 3002  Telephone: (519) 661-4122  Fax: (519) 661-3020

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