DESCRIPTION

The course is focused on basic fundamental aspects and advanced concepts in fluid mechanics. The course objective is to provide review of some fundamental topics from undergraduate curriculum that include conservation laws, dynamic similarity and introduction to boundary layer flows. The course then focuses on advanced topics that include detailed thin layer analysis, lubrication flow, turbulence, aerodynamics and airfoils.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in Mechanical & Materials Engineering, as well as any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student’s home program.

INSTRUCTOR CONTACT INFORMATION

Course instructor: Professor Roger Khayat
Office: SEB 3086, Tel. 519-661-2111, ext. 88253
Email: rkhayat@uwo.ca
Office hours: Virtual Office Hours: To be announced

TOPICS

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning Activities</th>
<th>Tentative timeline</th>
</tr>
</thead>
</table>
| Lesson 1: Background and integral form of the conservation equations | ● Lectures  
● Additional reading material  
● Help sessions/tutorial | Week 1 |
| Lesson 2: Inviscid flow. Euler equations       | ● Lectures  
● Additional reading material  
● Help sessions/tutorial | Week 2 |
| Lesson 3: Inviscid flow. Problem solving I    | ● Live/recorded lectures  
● Additional reading material  
● Help sessions/tutorial | Week 3 |
### Lesson 4: Inviscid flow. Problem solving II
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 4

### Lesson 5: Viscous flow. Navier-Stokes equations
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 5

### Lesson 6: Dimensional analysis
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 6

### Lesson 7: Viscous flow. Navier-Stokes equations. Applications I
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 7

### Lesson 8: Viscous flow. Navier-Stokes equations. Applications II
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 8

### Lesson 9: Boundary layer flow. Integral approach
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 9

### Lesson 10: Boundary layer flow. Scaling and differential approach
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 10

### Lesson 11: Turbulence.
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 11

### Lesson 12: Airfoil aerodynamics. Lift and drag characteristics
- Lectures
- Additional reading material
- Help sessions/tutorial

#### Week 12

### SPECIFIC LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>Degree Level Expectation</th>
<th>Weight</th>
<th>Assessment Tools</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth and breadth of knowledge</td>
<td>80%</td>
<td>Assignments, Examinations</td>
<td>Understanding of advanced concepts and theories, Understanding of analytical, computational and/or empirical methodologies to solve related problems</td>
</tr>
<tr>
<td>Application of knowledge</td>
<td>20%</td>
<td>Assignments, Examinations</td>
<td>Application of advanced concepts and theories, Awareness of important current problems in the field of fluid mechanics, Application of analytical, computational and/or empirical methodologies to solve related problems</td>
</tr>
</tbody>
</table>
ASSESSMENTS

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>Material Covered</th>
<th>Tentative Date</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework exercises/problems</td>
<td>All topics</td>
<td>Weekly*</td>
<td>10%</td>
</tr>
<tr>
<td>Term test 1</td>
<td>Conservation equations</td>
<td>Sep 26, 2022</td>
<td>20%</td>
</tr>
<tr>
<td>Term test 2</td>
<td>Boundary and thin layers</td>
<td>Oct 24, 2022</td>
<td>20%</td>
</tr>
<tr>
<td>Final exam</td>
<td>All topics</td>
<td>Nov 28, 2022</td>
<td>50%</td>
</tr>
</tbody>
</table>

- All dates are tentative

Activities in which collaboration is permitted:
- Practice problems

Activities in which students must work alone (collaboration is not permitted):
- Tests/exams

REQUIRED TEXTBOOK
No required textbook

OPTIONAL COURSE READINGS

CHEATING, PLAGIARISM/ACADEMIC OFFENCES
Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: [https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf)

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com ([http://www.turnitin.com](http://www.turnitin.com)).
CONDUCT
Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS SERVICES
As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at http://www.health.uwo.ca/.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment.

Students who are in emotional/mental distress should refer to Mental Health@Western: http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

SICKNESS
Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at: https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html

ACCESSIBLE EDUCATION WESTERN (AEW)
Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions,
mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): [http://academicsupport.uwo.ca/accessible_education/index.html](http://academicsupport.uwo.ca/accessible_education/index.html)

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.

**CHEATING, PLAGIARISM/ACADEMIC OFFENCES**
Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above under “Assessments” and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence (see Western’s scholastic discipline regulations for graduate students).

**SYNCHRONOUS LEARNING ACTIVITIES**
Students are expected to participate in synchronous learning activities as outlined in the course syllabus and/or described by the instructor. If you have issues that will impede your ability to participate in synchronous activities, please discuss with the course instructor at the beginning of the course.

**CONDUCT**
Students are expected to follow proper etiquette during synchronous and asynchronous activities to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in the synchronous and asynchronous learning activities and/or is not following the rules and responsibilities associated with the online learning activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

**HEALTH/WELLNESS**
As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services (remotely accessible) to help you achieve optimum health and engage in healthy living while
pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at http://www.health.uwo.ca/.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html
https://www.uwo.ca/health/psych/index.html

SICKNESS
Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

ACCESSIBILITY
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 Accessible Education at 661-2111 x 82147 or http://academicsupport.uwo.ca/accessible_education/index.html, for any specific question regarding an accommodation.