## MME 4485A/9515A - Fluid Machinery

## **COURSE OUTLINE – 2022-23**

Calendar Description:	Fluid turbo-machinery theory, performance characteristics of centrifugal and axial flow fans, compressors, pumps and turbines, fluid vibrations and sound, water hammer, introduction to fluid power controls and fluid amplifiers. Half course.
Prerequisites:	MME 3303a/b. Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.
Accreditation Units:	Engineering Science = 75%, Engineering Design = 25%
Instructor:	Professor C. Zhang; Phone: 88345; Room SEB 2065; email: <u>czhang@eng.uwo.ca</u> Office hours: Monday 4:30 – 5:30 p.m. through Zoom
Topics:	<ol> <li>Introduction, and dimensional analysis and similitude of turbomachines</li> <li>Open turbomachines</li> <li>Basic thermodynamics, fluid mechanics and definitions of efficiency</li> <li>Axial flow turbines</li> <li>Axial flow compressor, pumps and fans</li> <li>Centrifugal compressors, pumps and fans</li> <li>Radial flow turbines</li> </ol>
Learning Outcomes	<ul> <li>Upon successful completion of this course, students will be able to</li> <li>Identify various types of turbomachines and their principal applications</li> <li>Perform a similarity analysis between a laboratory tested model and a full scale turbomachine</li> <li>Apply basic conservation equations to predict the performance of different turbomachines</li> <li>Calculate efficiency of turbomachines</li> <li>Draw and use velocity triangle diagrams for axial and radial turbomachines</li> <li>Estimate losses for different stages</li> <li>Report experimental observations</li> <li>Interpret experimental outcomes in terms of the relevant theory</li> </ul>
Contact Hours:	3 lecture hours – M(5:30-6:30 p.m., SEB 1056);
	W(9:30-11:30 a.m., SEB 2100);
	2 laboratory/tutorial hours - TUT W(5:30-6:30 p.m., SEB 1056)
	LAB Tu(9:30-10:30 or 10:30-11:30 a.m., SEB 1074)
Textbook:	"Fluid Mechanics and Thermodynamics of Turbomachinery", 7 <sup>th</sup> Ed, by S L Dixon and C Hall, ISBN-13: 978-1-85617-793-1, Butterworth-Heinemann, Boston
Units:	SI and British Engineering
Assignments:	Each week starting from the $2^{nd}$ week till the $12^{th}$ week there will be an assignment (4-6 problems). These problems will indicate the level of student achievement expected. The students are not required to hand in the assigned problems for grading.

Tutorials:	During the tutorial periods, the teaching assistants will be available to help students with solving the assignment problems, to answer questions and to provide additional explanation of the lecture material if needed. There will be 2 quizzes held during the tutorial period.
Laboratories:	Each student will visit the lab twice for one hour during the lab period and conduct the two experiments (1) Axial flow fan performance test and (2) Reaction (Francis) turbine performance test. The laboratory will be conducted in groups of 3 students. Lab reports will be submitted as group reports for undergraduate students and individual reports for graduate students and are due <b>one week</b> after the experiment is conducted.
	You should read the instruction sheet and section of the text dealing with the theory related to the experiment before you come to the laboratory. Laboratory attendance is compulsory. You will be required to record your experimental data neatly and have these signed by the laboratory instructor before you leave the lab.
Examination and Quizzes:	Quizzes – Closed book, two summary pages (8.5"x11", both sides) and non-programmable calculator are allowed. Mid-term test and final exam – Open book.
Evaluation:	Quiz #16%Quiz #24%Laboratories10% (5% for each lab)Mid-term test25%Final Examination55%
	Quizzes – Oct. 5 and Nov. 23, 2022, 5:30 – 6:30 p.m. Mid-term test - Oct. 25, 2022, 9:30. – 11:30 a.m.
Course Policies:	Laboratories
	Laboratory attendance is compulsory.
	• Passing the laboratory component of the course (i.e. at least 50% mark in the laboratory component) is necessary to pass the course
	• Students who arrive 30 min after the scheduled lab time or miss the lab without academic consideration will be given one time only chance to conduct the lab (at a rescheduled time) with 50% penalty.
	• Students who miss a lab with academic consideration are required to reschedule the lab by contacting the course instructor. Failure to do so will result in a zero mark for that lab
	• Missing both labs without academic consideration will result in the course failure
	Quizzes
	• No make-up quiz options will be offered regardless of the circumstances for which the quiz was missed
	• Missing one quiz with academic consideration will automatically shift the weight of the missed quiz into other quiz
	• Missing both quizzes with academic consideration will automatically shift the weight of the missed quizzes into the final exam
	• Missing a quiz without academic consideration will translate into a zero mark for that quiz
	Midterm exam
	• No make-up midterm options will be offered regardless of the circumstances for which the midterm was missed

	• Missing the midterm with academic consideration will shift the weight of the missed midterm exam into the final exam
	• Missing the midterm exam without academic consideration will translate into a zero mark for the midterm
	Final exam
	• If a minimum of 50% is not obtained on the final examination, the student will be assigned a grade of no greater than 48% for the course.
	• If you miss the final exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).
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.
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.
Academic Policies:	The website for Registrar Services is http://www.registrar.uwo.ca.
	In accordance with policy,
	https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,
	the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.
	All electronic devices including cell phones are not allowed in the exams except for the non-programmable calculator for quizzes and laptop for both the term test and final exam. But you can access your laptop for course materials by the mouse or touchpad only.
	<b>Scholastic offences</b> are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:
	http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergra d.pdf.
Accommodation Policies:	Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:
	https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.
Religious Accommodation:	When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

## https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

Support Services: Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student\_support/survivor\_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed 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

http://academicsupport.uwo.ca/accessible\_education/index.html

if you have any questions regarding accommodations.

*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.