AM 2276a – APPLIED MATHEMATICS FOR ELECTRICAL AND MECHANICAL ENGINEERING III

COURSE OUTLINE: INTERSESSION 2020

CALENDAR DESCRIPTION:

Topics covered include a review of orthogonal expansions of functions and Fourier series and transforms, multiple integration with methods of evaluation in different systems of coordinates, vector fields, line integrals, surface and flux integrals, the Green, Gauss and Stokes theorems with applications.

COURSE INFORMATION:

Instructor: Joshua LeClair
Virtual Office Hrs: TBA
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ANTIREQUISITES:

Calculus 2302A/B, Calculus 2303A/B, Calculus 2502A/B, Calculus 2503A/B, Applied Mathematics 2277A/B, the former Applied Mathematics 2411, the former Applied Mathematics 2413, the former Applied Mathematics 2415.

PREREQUISITES:

Applied Mathematics 2270A/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.

COURSE OBJECTIVES:

Many of the physical quantities that we work with as engineers are best described as scalar fields (mass density and charge density) or vector fields (velocity, heat flux, electrical, and magnetic fields). The main objective of this course is to learn how to "do calculus" with these sorts of mathematical objects – namely, how do we differentiate and integrate multivariable functions and vector-valued functions? Taking a more contemporary approach to the material, we will touch on examples from robotics, data science, mechanics, and biology.

Throughout the course, we will place an equal emphasis on concepts ("What does the math mean?"), computations ("How do I actually *do* the math?"), and applications ("What are these tools and concepts actually good for?"). To this end, all evaluations will encourage you to refine your mathematical communication skills and will emphasize the importance of connecting mathematical conclusions to real-world applications.

TEXTS **(REQUIRED):**	Ghrist, W. Robert. *Calculus BLUE Multivariable Volume 1: Vectors & Matrices.* Agenbyte Press, 2015 *(3rd edition).* https://amzn.to/2KJ2aSk

Ghrist, W. Robert. *Calculus BLUE Multivariable Volume 2: Derivatives.* Agenbyte Press, 2016 *(3rd edition).* https://amzn.to/3f16gmY

Ghrist, W. Robert. *Calculus BLUE Multivariable Volume 3: Integrals.* Agenbyte Press, 2016 *(3rd edition).* https://amzn.to/35dWw48

Ghrist, W. Robert. *Calculus BLUE Multivariable Volume 4: Fields.* Agenbyte Press, 2018 *(3rd edition).* https://amzn.to/3aPkxQ5

Please note that the above are (only) available as low-cost **eBooks** through the Amazon Kindle Store. These volumes will supplement the Calculus BLUE "video-text" that we will be using throughout the course (links to video content will be made available on OWL). Homework problems from the eBooks will be assigned regularly.

REFERENCES: Zill, G. Dennis. *Advanced Engineering Mathematics*. Jones and Bartlett, 2016 (5th or 6th Edition)

Boas, L. Mary. *Mathematical Methods in the Physical Sciences*. Wiley, 2005 (3rd Edition)

Neither of these books are required. However, they are great resources for extra practice problems (Zill) or alternative explanations of concepts (Boas).

EVALUATION:

Journals*	10%	(2% each, best 5 of 6 will count towards mark)
Assignments	15%	(2 equally weighted assignments)
Term Oral Exam	10%	(May 28-29)
Term Test	15%	(Due June 14)
Final Project	20%	(Due June 26)
Final Oral Exam	30%	(Exam Period, June 29-30)

Recognizing that some students might be better at demonstrating their knowledge through written evaluations rather than oral evaluations (or vice versa), the following **alternative weightings** will be available:
  I.   If you perform better on the Term Oral Exam than the Term Test, each will be worth 12.5%
  II. If you perform better on the Final Project than the Final Oral Exam, each will be worth 25%

*Journals will be due weekly throughout the first 6 weeks of the course. These will be submitted via OWL and will consist of a few (short) reflection questions. My hope is that these will encourage you to keep up with the material each week and offer you an opportunity to seek clarification on any concepts that may have been unclear.

NOTE: **Oral examinations will be conducted via videoconferencing software. Therefore, completion of this course will require you to have a reliable high-speed internet connection and an internet-ready device with a webcam and microphone.**

COURSE POLICIES:

General Expectations

- Students are expected to check OWL regularly for course material. announcements, information, etc.
- Students are expected to complete associated readings and suggested exercises at a steady pace throughout the term. This is particularly important given the condensed nature of the course!

Evaluation

- Evaluation criteria are based strictly on achievement. Claims of an excellent academic history, of attendance in the course, or of personal issues (family, relationship, financial, etc.) cannot be used to justify a higher grade in the course.
- No extra assignments, essays, problem sets, or other work of any kind will be offered to any student for extra credit.
- The requirement for a higher grade (to maintain a scholarship, for admission to a graduate program, etc.) is not a justifiable reason for modifying a grade (ie. no grades will be "bumped").

Term Test

- No make-up options will be offered regardless of the circumstances for which the test was missed.
- Missing the term test with academic consideration will automatically equally distribute the weight of the missed test into the Final Project and Final Oral Exam.
- In the case of a missed term test, a student is ineligible for alternative weighting scheme I.

Term Oral Exam

- If the oral exam is missed with academic consideration, an alternate time will be arranged in consultation with the student.
- If the oral exam is missed with academic consideration and alternative arrangements cannot be made in a timely manner, the weight of the missed assessment will be shifted to the Final Oral Exam.
- In the case of a missed Term Oral Exam, a student is ineligible for alternative weighting scheme II.

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 (see Scholastic Offense Policy in the Western Academic Calendar). Scholastic offences 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_undergrad.pdf.

ACADEMIC ACCOMODATION: If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. During the COVID-19 pandemic, medical notes are not required. Medical absence can be reported through the *Student Illness Reporting Tool* at:

https://www.registrar.uwo.ca/academics/academic_considerations/index.html.

If this portal is not available (i.e., if the COVID-19 pandemic has lifted before the end of the course), or if you have missed (or will be missing coursework) for a non-medical reason beyond your control, approval can be granted either through a *Self-reported Absence* (if the portal is available) or via the Dean's Office/Academic Counselling unit of your Home Faculty. Non-medical reasons must be accompanied by supporting documentation. If you are a Science student, contact information for the Academic Counselling Office for the Faculty of Science is available at:

https://www.uwo.ca/sci/counselling/.

In all cases, you must contact your instructor as soon as possible, and no later than 24 hours after the period covered, to clarify how you will be expected to fulfil the academic expectations you have missed (unless other instructions are indicated in this Course Outline). For further information, please consult the University's policy on academic consideration for student absences:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf.

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam).

SUPPORT SERVICES: A list of services offered by the Office of the Registrar can be found at www.registrar.uwo.ca. Students who are in emotional/mental distress should refer to Mental Health @ Western (www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help. Additional student-run support services are offered by the USC. Visit www.westernusc.ca/services for details.

APPROXIMATE SYLLABUS:

Week of	Topic(s)	Evaluations	Learning Outcomes
May 11	Curves, surfaces, and coordinate transformations: looking at geometry through the lens of algebra.	Journal I – Due	Understand how to describe curves and surfaces algebraically.
May 18	Hello again, linear algebra: from abstract vector spaces to Fourier series.	Journal II – Due	Construct a Fourier series from an orthogonal set of basis functions.
May 25	Derivates of multivariate and vector functions: partial derivatives and directional derivatives.	Journal III – Due Term Oral Exam	Understand how the notion of a derivative generalizes to higher dimensions and vector-valued functions.
June 1	Multiple integrals with applications to solid body mechanics.	Journal IV – Due Assignment I – Due	Gain proficiency computing double and triple integrals in the context of engineering applications
NOTE: June 8 is the Last Day to Drop a 6 week Intersession course without academic penalty			
June 8	Surface integrals and multiple integrals in non-Cartesian coordinate systems. Introduction to fields and scalar path integrals.	Journal V – Due Term Test	Identify appropriate coordinate systems in which to evaluate multiple integrals and surface integrals.
June 15	Work, circulation, and flux. Green's Theorem, Gauss' Theorem, and Stokes' Theorem.	Journal VI – Due Assignment II – Due	Be able to evaluate and interpret the physical significance of vector-valued integrals.
June 22	Applications: Solving real-world problems using the Integral Theorems	Final Project – Due	Apply Stokes', Green's and Gauss' Theorems to an engineering problem

June 29-30
Final Exam Period

**Coverage and assignment deadlines subject to change as course progresses