Math 309 (C1) Spring - Summer 2018

Mathematical Methods for Electrical Engineers

Lecture C1: May 7 – August 3, 2018

Course Information

Department of Mathematical and Statistical Sciences
University of Alberta

Lecture C1: M W F 11:00 - 11:50 MEC 2-3

Instructor: I. E. Leonard, 679 CAB

e-mail: ileonard@ualberta.ca

web: http://www.math.ualberta.ca/~isaac/

(class notes, handouts, solutions, etc. will be available here)

office hours: T & Th 10:00 - 12:00 in CAB 679, or by appointment

Course Objectives:

Students will learn the basic mathematical operations with complex numbers and mappings in the complex plane, the basic properties of standard complex functions, differentiation and integration of complex functions, Taylor and Laurent series, applications of the theory to evaluation of specific improper integrals, inverse Laplace transforms and Fourier series.

Course Description:

Complex numbers, analytic functions, elementary functions, Cauchy-Riemann equations, Cauchy-Goursat Theorem, Cauchy Integral Formula, applications to harmonic functions, series representations of analytic functions, power series, Taylor series, Laurent series, residue theory, inverse Laplace transform. Complex inner product spaces, orthogonal expansions, Gram-Schmidt orthogonalization, completeness, Fourier expansions, Parseval's relation and Bessel's inequality.

Course Prerequisites:

Math 209.

Required Textbook:

- *Fundamentals of Complex Analysis with Applications to Engineering and Science*, Third Edition, by E. B. Saff and A. D. Snider.

Recommended reading:

- *Complex Variables and Applications*, any edition, by J. W. Brown and R. V. Churchill.
- *Math 309 Notes*, by Professor W. Allegretto. (posted on the course webpage)
- *Complex Analysis with Applications*, any edition, by D. G. Zill and P. D. Shanahan. (Online at Jones and Bartlett: http://www.jblearning.com)
- *Basic Complex Analysis*, Second Edition, by J. E. Marsden and M. J. Hoffman.
- *Elements of Complex Variables*, by L. L. Pennisi.
- *Complex Analysis with an Eye towards Electrical Engineering*, by J. D. Lewis.

Assignments:

There will be 7 or 8 problem sets given during the term, approximately one every two weeks. Each problem set will consist of approximately 10 problems.

Problem sets will not be collected for marking. Solutions to the problem sets will be posted on the

course webpage:

web: http://www.math.ualberta.ca/~isaac/math309/ss18

The examination problems will be similar to problems from these problem sets.

Examinations:

Midterm Exam I ..... covers Chapters 1 – 4 ..... MEC 2-3, Friday June 8, 2018 ..... 20%
Midterm Exam II ..... covers Chapters 4 – 7 ..... MEC 2-3, Friday July 13, 2018 ..... 30%
Final Exam .... covers entire course ..... 9:00 - 11:00, Tuesday August 14, 2018 ..... 50%

Grade Evaluation:

The final grades are not curved, the grade distribution is as follows:

Grade	Percent	Grade	Percent
A+	95 – 100	C+	65 – 69
A	90 – 94	C	60 – 64
A−	85 – 89	C−	55 – 59
B+	80 – 84	D+	50 – 54
B	75 – 79	D	45 – 49
B−	70 – 74	F	0 – 44

The instructor reserves the right to make minor adjustments to the above distribution in order to obtain an overall fair grading scheme.

Deadlines:

For the 13-week Spring and Summer courses running May 7 - August 3, 2018, note the following deadlines:

Last day to **Add/Drop Courses:** May 18, 2018

Last day for **50% Refund:** June 7, 2018

Last day to **Withdraw:** July 18, 2018

Format of Examinations:

Midterm Exams: 50 minute written examinations. No calculators, cell phones or other electronic equipment, or course materials are allowed.

Final Exam: 2 hour written examination. No calculators, cell phones or other electronic equipment, or course materials are allowed.

Missed Term Examinations:

A student who cannot write the quiz or the midterm examination because of an incapacitating illness, severe domestic affliction or other compelling reasons can apply for deferral of the weight of the missed quiz or examination to the final examination.

Applications for deferral of term work must be made in writing to the *instructor*, with supporting documentation, within 48 hours of the missed quiz or examination date.

Deferral of term work is a privilege and not a right; there is no guarantee that a deferral will be granted. Misrepresentation of facts to gain a deferral is a serious breach of the *Code of Student Behaviour*.

Deferred Final Examination:

A student who cannot write the final examination because of an incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination.

Such an application must be made to the student's Faculty Office within 48 hours of the missed examination.

Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. Misrepresentation of facts to gain a deferral is a serious breach of the *Code of Student Behaviour*.

If granted, the deferred final examination for this course will be held at a time and location convenient to both the student and the instructor.

Reexamination:

A student who writes the final examination and fails the course may apply to the Faculty of Science for a reexamination. It should be noted that reexaminations are rarely granted in the Faculty of Science. These exams are governed by University (Calendar section 23.5.5) and Faculty of Science Regulations (Calendar Section 192.5.3). Misrepresentation of facts to gain a reexamination is a serious breach of the *Code of Student Behaviour*.

Student Responsibilities:

Academic Integrity:

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the *Code of Student Behavior* (online at http://www.ualberta.ca/secretariat/appeals.htm) and avoid any behavior which could potentially result in suspicion of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All forms of dishonesty are unacceptable at the University. Cheating, plagiarism, and misrepresentation of facts are serious offenses. Anyone who engages in these practices will receive at minimum a grade of zero for the examination or paper in question and no opportunity will be given to replace the grade or redistribute the weights. Any offense will be reported to the Senior Associate Dean of Science, who will determine the disciplinary action to be taken.

Examinations:

Your student photo I.D. is required at examinations to verify your identity. Students will not be allowed to begin an examination after it has been in progress for 30 minutes. Students must remain in the examination room for at least 30 minutes from the time the examination commenced. Electronic equipment is not to be brought to the examination.

Cell Phones:

Cell phones are to be turned off during lectures, labs, and seminars. Cell phones are not to be brought to examinations.

Students with Disabilities:

Students who require accomodation in this course due to a disability are advised to discuss their needs with Specialized Support and Disability Services (215 Central Academic Building).

Academic Support Centre:

Students who require additional help in developing strategies for better time management, study skills, or examination skills, should contact the Academic Support Centre (2-703 Student Union Building).

Additional tutorial services are available through the Mathematics and Applied Sciences Centre (289 Central Academic Building).

http://www.uofaweb.ualberta.ca/MASC/

Lecture Topics Selected From:

1. Complex Numbers

- 1.1 The Algebra of Complex Numbers
- 1.2 Point Representation of Complex Numbers
- 1.3 Vectors and Polar Forms
- 1.4 The Complex Exponential
- 1.5 Powers and Roots
- 1.6 Planar Sets
- 1.7 The Riemann Sphere and Stereographic Projection

2. Analytic Functions

- 2.1 Functions of a Complex Variable
- 2.2 Limits and Continuity
- 2.3 Analyticity
- 2.4 The Cauchy-Riemann Equations
- 2.5 Harmonic Functions
- 2.6 Steady-State Temperature as a Harmonic Function

3. Elementary Functions

- 3.1 Polynomials and Rational Functions
- 3.2 The Exponential, Trigonometric, and Hyperbolic Functions
- 3.3 The Logarithmic Function
- 3.4 Washers, Wedges, and Walls
- 3.5 Complex Powers and Inverse Trigonometric Functions
- 3.6 Application to Oscillating Systems

4. Complex Integration

- 4.1 Contours
- 4.2 Contour Integrals
- 4.3 Independence of Path
- 4.4 Cauchy's Integral Theorem
  - 4.4a Deformation of Contours Approach
  - 4.4b Vector Analysis Approach
- 4.5 Cauchy's Integral Formula and Its Consequences
- 4.6 Bounds for Analytic Functions
- 4.7 Applications to Harmonic Functions

5. Series Representations for Analytic Functions

- 5.1 Sequences and Series
- 5.2 Taylor Series
- 5.3 Power Series
- 5.4 Mathematical Theory of Convergence
- 5.5 Laurent Series
- 5.6 Zeros and Singularities
- 5.7 The Point at Infinity
- 5.8 Analytic Continuation