

## Course Syllabus

**Course:** ChE 132A: Analytical Methods in Chemical Engineering

**Credit hours:** 4

**Contact hours:**  $2 \times 75 \text{ min} + 1 \times 50 \text{ min}$  (ESB 1003) per week

**Instructor:** James B. Rawlings

**Text:** Potter, Lessing, and Aboufadel (2020)

**Supplementary materials:** The class website is available on Canvas.

**Course description:** Develop analytical tools to solve elementary partial differential equations and boundary value problems. Separation of variables, Laplace transforms, generalized Fourier series and analysis, and computer math tools.

**Prerequisites or co-requisites:** Mathematics 4B or 4BI; Mathematics 6A or 6AI.

**Required or elective course:** Required

**Specific outcomes of instruction:**

1. Identify, derive, and solve common ODEs in engineering applications.
2. Compute Laplace Transforms and use them to solve ODEs.
3. Use separation of variables techniques to solve boundary value problems in transport phenomena, including heat conduction and diffusion equations.
4. Use techniques in generalized Fourier analysis to solve PDEs.
5. Use computational tools to solve ODEs and PDEs and visualize their solutions.

**ABET student learning outcomes (SLOs) addressed by the course:**

SLO 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

SLO 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

**Course Specific Information.**

**Review: (week 1)**

- infinite series, ratio test
- complex variables, polar form
- linear algebra, norm, inner product, least squares

### ODEs (weeks 2-3)

- Different types, general solution procedures for 1st order and 2nd order
- Integrating factors, Wronskians, undetermined coefficients, variation of parameters
- Taylor Series, Power Series Solutions, Bessel's ODE and Bessel functions

### Laplace Transforms (weeks 3-5)

- Computing and inverting them
- Shifting theorems and convolutions
- Transforming ODEs into algebraic equations
- Solving systems of ODEs

### Fourier Analysis (weeks 5-6)

- Fourier Sine and cosine series, orthogonality
- Generalized Fourier series
- Bessel functions

### PDEs (weeks 7-10)

- Where they appear in ChE: diffusion, fluids, waves
- Initial and boundary value problems
- Separation of variables, similarity transforms
- Differential operators in various coordinate systems
- Eigenfunction expansions

### Grading.

- 20% homework. Posted on Canvas. Scan your homework and upload onto Gradescope. Late assignments will not be accepted without a verified excuse.
- 40% midterm exam (Tuesday, May 5, 12:30 pm-1:45 pm during usual class time, Engr II 1519).
- 40% final exam (Thursday June 11, 4:00 pm-7:00 pm, Engr II 1519).

All of the work you turn in must be your own. Cheating is not tolerated and will be dealt with very seriously (a zero on an assignment, exam, a failing grade in the course, and referral to Judicial Affairs). See following UCSB Academic Integrity Policy. Solving ODEs and PDEs can be challenging; you will only become good at it through practice. As such, 20% of the overall grade will be based on homework assignments. Attendance at recitation is strongly recommended.

**Contact Information.**

Instructor	James B. Rawlings	jbraw@ucsb.edu
Office Hrs	F 9:00 a.m.	
T.A.	Zak Al Kharusi	alkharusi@ucsb.edu
Office Hrs	T 2:00 p.m.	

**References**

M. C. Potter, J. L. Lessing, and E. F. Aboufadel. *Advanced Engineering Mathematics*. Springer International Publishing, 4th edition, 2020. ISBN 9783030170707.

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**Academic Accommodations.** Students needing academic accommodations based on a disability must contact the Disabled Students Program (DSP) at (805) 893-2668 or in person at the Student Resource Building, Room 2120. Students must contact DSP within the first two weeks of the term as reasonable notice is needed to coordinate accommodations. For more information on how DSP may be able to work with you, visit <http://dsp.sa.ucsb.edu>.

Students are also encouraged to be familiar with UCSB’s Counseling and Psychological Services (CAPS), which offers a broad range of support services available to all registered students. You may call (805) 893-4411 to schedule an appointment, or to reach a clinician 24 hours a day about immediate concerns or crises. Appointment scheduling and walk-in Brief Assessments are also available CAPS Main Office in Building 599. Visit <http://caps.sa.ucsb.edu> for details.