MAE294A/SIOC203A: Methods in Applied Mechanics Fall Quarter 2018
http://web.eng.ucsd.edu/~sgls/MAE294A_2018

Preliminaries

Instructor

My names is Stefan LLEWELLYN SMITH. My e-mail address is sgls@ucsd.edu. My e-mail address is sgls@ucsd.edu, but if you have a question, talk to me before or after class, or come to office hours.

Schedule

MWF 12–12:50 pm in Pepper Canyon Hall 120. Office hours: Thursdays, around 930–1100 in EBU II 574 and Keck 365. TA: Tianyi Chu tic123@eng.ucsd.edu, office hours by appointment, problem class 3–4 pm in EBU II 305.

Homework

There will be six graded homeworks and one review homework. They should be posted a week before they are due with a clear date to hand them in. No late homework will be accepted; hand in (or get someone else to hand in) what you have done on the due date. Regrades: you should write a short explanation and turn it in to Tianyi within one week of the homework's due date.

Website

See top of page. The homework and solutions will be posted on the website.

Assessment

The grade in this course is based on homeworks, a midterm, and a final exam. An approximate division is 20%, 30% and 50%, but this is by no means definite. Exams will probably be "open-note and open-textbook", i.e. you may bring in hand-written material and the textbook. No calculators, no cell phones, no computers during midterm or final exams. There will be make-up exams except in exceptional circumstances.
Your final grade is the culmination of a quarter-long effort. I do not like giving C grades and lower for graduate courses. Please try and keep me happy.
I encourage you to discuss the material among yourselves. When it comes to assigned homework however, everything you turn in should be essentially your own. If you and a friend have worked too closely on a problem, please say so. Needless to say, collaboration is not permitted during exams.

Prerequisites

Calculus, differential equations, linear algebra, complex analysis, freshman physics. This is a graduate class. If you think you can master the material concurrently, you can try.

Textbooks

The "textbook" for this class is *Mathematical Methods for Physics and Engineering* by Riley, Hobson and Bence (RHB; 2006, Cambridge University Press, 3rd edition, 1362 pages). It's probably worth buying. I have placed it on reserve at the library. Two other useful books, on reserve at the library, are *Advanced mathematical methods for scientists and engineers* by Bender and Orszag and *Advanced Calculus for Applications* by Hildebrand.
A classic reference on the subject as a whole is *Methods of Mathematical Physics* by Jeffreys & Jeffreys. A remarkable book even today. Two other good books on the material we cover, which concentrate on the physical background, are *Methods of Mathematical Physics* by Mathews & Walker, and *Mathematical Methods for Physicists* by Arfken (I prefer the second edition). Good references for complex analysis are *Functions of a Complex Variable* by Carrier, Krook & Pearson, and *Complex Variable* by Ablowitz & Fokas. An advanced book for PDEs is *Applied Partial Differential Equations* by Ockendon et al.
You should start becoming familiar with mathematical handbooks. The one true word is in the *Handbook of Mathematical Functions*, formerly edited by Abramowitz and Stegun, but now replaced by the Digital Library of Mathematical Functions, available online and in hard copy. For integrals, series and products, see *Table of Integrals, Series, and Products* by Gradshteyn & Ryzhik (many editions).

Rough syllabus

I will cover material from Chapters 14–18 and 20–21 of RHB, but not all of it and not in the same order.
Basic solutions of linear and nonlinear ODEs. Green's functions for ODEs. Sturm–Liouville theory. First order PDEs. The method of characteristics. Classification of PDEs and important examples (heat, Laplace and wave equations). Separation of variables. Green's functions for PDEs. Similarity solutions.
294B/203B (Winter) will cover approximate solutions to ODEs, multiple scales, phase plane, boundary layers, WKB and asymptotic methods. 294C/203C (Spring) will cover topics such as complex and Fourier analysis, Laplace transforms, shocks, nonlinear PDEs and using integral transforms to solve PDEs.

Academic integrity

See UCSD's policy on (tere is a link on the class web page). Don't do it.

OSD Accommodation

Please come and see me at least two weeks before exams to discuss.

Stefan G. Llewellyn Smith

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Research interests:

Fluid dynamics. Acoustics and fluid-structure interactions. Asymptotic methods. Industrial mathematics.

Interests:

Japanese; food and cocktails; rowing; tennis (not enough time).

Education:

• Queens' College, University of Cambridge, 1993–Oct 1996. PhD 1996.

• Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, 1992–1993.

• Queens' College, University of Cambridge, 1988–1992. Certificate of Advanced Study (Part III of the Mathematical Tripos) with Distinction, 1992. BA (Honours) First Class (Parts IA, IB & II), 1991.

Most recent publications:

A-72 Taylor, C. K. & Llewellyn Smith, S. G. 2016 Dynamics & transport properties of three surface quasigeostrophic point vortices. *Chaos*, *26*, 113117.

A-73 Zannetti, L., Ferlauto, M. & Llewellyn Smith, S. G. 2016 Hollow vortices in shear. *J. Fluid Mech.*, *809*, 705–715.

A-74 van der Wiel, K., Gille, S. T., Llewellyn Smith, S. G., Linden, P. F. & Cenedese, C. 2017 Characteristics of colliding sea breeze gravity current fronts: a laboratory study. *Q. J. Roy. Met. Soc.*, *143*, 1434–1441.

A-75 Freilich, D. G. & Llewellyn Smith, S. G. 2017. The Sadovskii vortex in strain. *J. Fluid Mech.*, *825*, 479–501.

A-76 Llewellyn Smith, S. G. 2018 A note on "Quasi-analytical solution of two-dimensional Helmholtz equation". *Appl. Math. Modelling*, *54*, 281–283.

A-77 Rypina, I. I., Llewellyn Smith, S. G. & Pratt, L. J. 2018 Connection between encounter volume and diffusivity in geophysical flows. *Nonlin. Proc. Geophys.*, *25*, 267–289.

A-78 Cumberbatch, E. & Llewellyn Smith, S. G. 2018 Current/Voltage characteristics ofthe short-channel double-gate transister. Part I. *SIAM J. Appl. Math.*, *78*, 877–896.

A-79 Gagniere, S., Llewellyn Smith, S. G. & Yeh, H.-D. 2018 Excess pore water pressure due to ground surface erosion. *Appl. Math. Modelling*, *61*, 72–82.

A-80 Luca, E. & Llewellyn Smith, S. G. 2018 Stokes flow through a two-dimensional channel with a linear expansion. Accepted by *Q. J. Mech. Appl. Math.*

A-81 Llewellyn Smith, S. G., Chang, C., Chu, T., Blyth, M., Hattori, Y. & Salman H. 2018 Generalized contour dynamics: a review. Accepted by *Reg. Chaotic. Dyn.*