PROJECTS APPM 4360/5360 Spring 2019

Methods in Applied Mathematics– Complex Variables and Applications

Instructor: M.J. Ablowitz

The project will consist of a written report and a talk of 30 minutes plus 5 minutes for questions. **The project will be due and scheduled during last week in the course: April 29-May 2.** Specific times will be announced later in the course. Students should work together in groups of three.

All names of the participants, the project title and a short abstract of 75-100 words **must be handed in at class Monday March 11**. One title/abstract is sufficient for each group. Below is a list of possible projects; others are possible. MJA must approve all projects. **Please remember: this is a mathematics course. It is not a physics/engineering course or numerical course or probability course etc. Mathematical ideas/concepts/methods in complex analysis must be central.**

Possible projects:

–Applications of complex variables to fluid dynamics/electrostatics/heat conduction etc. Include applications beyond what was covered in class. Many books on fluid dynamics/electromagnetics etc. cover this topic;

–Infinite product and Mittagg-Leffler expansions–section 3.6. Supplement with examples applications other references;

–Differential equations in the complex plane–Painlevé type equations–section 3.7; applications: possible reference: Ablowitz & Clarkson CUP 1991;

–Computational methods in the complex plane–section 3.8. Supplement with examples, applications, use other references from the literature. **Make sure complex analysis leading to the computational method is an important component.**

–Conformal mapping: polygons– Schwarz-Christoffel transformation section 5.6; fundamental mapping of a rectangle and elliptic functions –supplement with other applications, references.

–Conformal mapping: circular polygons-section 5.8 fundamental mapping circular triangle Schwarz triangle functions; e.g. discuss relationship to the Chazy equation/Darboux-Halphen equation;

-Numerical Conformal mapping: polygons: numerical implementation of the Schwarz-Christoffel transformation; possible reference: Driscoll-Trefethan, CUP 2002; others can be found in the literature;

-Numerical Conformal mapping: fluid dynamics, or other applications; references can be found in the literature;

-Asymptotic evaluation of integrals: Laplace, stationary phase, steepest descent, WKB methods: see Chapter 6. Supplement with other references, examples. There are numerous potential projects within this subtopic.

–Riemann-Hilbert (RH) problems: scalar RH problems: closed/open contours, relate to singular integral equations; matrix RH problems: see Chapter 7. Supplement with applications examples. There are many possible projects within this subtopic; e.g. nonlinear waves: integrable equations, Inverse Scattering Transform. Ref. Ablowitz CUP 2011.

–Generalized Cauchy Integral Formula (GCIF)–Sect. 2.6.3. Derivation and applications of GCIF include nonlinear waves 'KP' equation: reference: Ablowitz & Clarkson, CUP 1991;

ALL PROJECT PRESENTATIONS will be held during the week of April 29-May 2 during 5:00PM–10:00PM. On Tues April 30 and Thursday May 2 room will be ECCR 108; on Monday April 29 and Wednesday May 1 room will be ECCR 257 (APPM Newton Lab).

Information provided by M. Ablowitz, 2/24/2019